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BOILER CORROSION.

The introduction of various chemicals, usually designated as boiler compound, into steam boilers to prevent the formation of scale, is a common and time-honored practice. Unless some method for scale-prevention is applied, where only hard water is available for feed, the boiler is liable to be thrown frequently out of commission to undergo cleaning. In addition to the inefficiency in conducting heat which is due to scale, there is always the possibility of burning the plates and tubes, which leads to expensive repairs. Water softening, either before or after its introduction into the boiler, is consequently regarded with favor wherever the condition of the feed indicates its need.

The prevention of corrosion in boilers is a matter which has received less attention. It has been pretty well established that the corrosion of iron, if not entirely an electrolytic process, is at least largely so, and it can be depended upon to proceed most rapidly when the conditions are favorable for electrolytic action. When it is desired to inhibit corrosion, conditions must be made unfavorable for electrolytic action.

Spontaneous electrolytic action arises from the presence of two metals in contact, or of two portions of the same metal in dissimilar states. Sufficient dissimilarity seems to be produced by subjecting two parts of the same piece of material to different mechanical treatment, and even by less evident causes. The electrolyte necessary to complete a little primary battery may be furnished by a film of moisture on the surface, but of course is always present in quantity in a steam boiler. Impurities in the iron seem to be the most fruitful source of the local action resulting in corrosion, and manganese in particular has been credited with a large part of the damage. The demand for the so-called ingot iron, from which the manganese has been largely eliminated, arose principally on this account.

Several possibilities present themselves for making the conditions unfavorable for electrolytic action. One of these is to have the water chemically pure, since pure water is not an electrolyte, but this is of course not practicable in the case of steam boilers. Another method is to control the flow of current and direct it so that the iron does not form the pole at which oxygen is liberated. For instance, a stick of zinc may be suspended in the boiler, and connected to the

iron, since zinc is more positive in the electrochemical series. To make the flow of current more certain, a battery may be externally connected between the zinc and the iron of the boiler, and a current thus forced through by means of an external electromotive force. This method is reported to be giving satisfactory results in Australia, and is now being tried on the locomotives of the Canadian Pacific Railway.

Another method consists in making the iron "passive," so that local electrolytic action is not set up. This may be accomplished by the presence in the water of dissolved potassium bichromate. The result is usually attributed to the formation upon the surface of a thin layer of oxide, everywhere homogeneous, which protects the metal beneath. It may be likened to the amalgamation of zinc for primary batteries, protection from local action being secured by a homogeneous surface. While this protection may be secured in the case of reasonably pure water, it has been recently shown by Friend and Brown that where other salts are present in the water, immunity is not secured. In the case of boiler feed water, other salts may well be present, and better results can then be attained by using potassium chromate as inhibitor. Ten pounds of the salt in 1,000 gallons of water exerts a marked retarding effect upon corrosion. Larger quantities are only slightly more beneficial. While these experiments have only been carried out upon a laboratory scale, they indicate sufficient success to warrant a trial under working conditions in a steam-boiler plant.

THE MOTOR DRIVE IN TEXTILE PRINT WORKS.

The extension of the motor drive into all branches of the textile industry continues to demonstrate the advantages of this class of load to electric lighting and power companies interested in enlarging their long-hour service earnings. The economic benefits of the electric drive by individual motors are much the same in all manufacturing establishments; but now and then the power engineer finds that the installation of electricity is a peculiarly fortunate development, through the opportunities afforded to utilize the machine units in forced production and to suspend operations in one department or another without sustaining heavy losses in fuel or increasing the maintenance of the driving arrangements in undue relation to the volume of business. In the modern textile print works these points are of special interest.

In establishments of this kind the tendency is for the machines to be greatly scattered. The product is not uniform from season to season, being dependent to a large extent upon the dictates of fashion, and in a single season or even in a single day, the plant may be operated in what would be properly called haphazard ways in a cotton or woolen mill, part of the machines being in service during certain hours of the day, and various proportions being shut down in other hours. The cloth in the print works will rarely pass through all the machines installed, and often not through half the equipment. The function of the works is obviously to give the cloth an appearance that will render it salable, and to meet this requirement a sheer finish may be called for at one time with consequent use of singeing machines, or a napped finish at another, when the singers will be used but little. In the most active hours of the working day various machines may be standing idle, and yet the plant may be doing a thriving business. Such conditions are excellent for the installation of individual motor drives, and the well known advantages of consuming power only when machines are in operation, and of maintaining conditions of the greatest cleanliness without slowing down the volume of production, are especially valuable here.

In the print works there is on the whole not a great difference to be expected between the cost of installing individual and group driving. The reason is that the lack of compactness in the machinery arrangement requires unusually heavy shafting and belting equipment, where the steam engine or group drive with few motors is provided. This means that the capacity of motors for individual driving will not much exceed the total rating of motors applied to a plant on the group basis. In such plants only a few machines can be connected to a single motor without neutralizing some of the benefits of the electric drive, and in a measure going back to the old inefficiencies and inconveniences of the steam-engine system of operation. Again, there is a demand for more or less speed regulation and adjustment in the print works. The singeing machine, taking from two to six horsepower, according to its size, is run at different speeds, depending upon the time required to apply the proper amount of heat; washing machines, running at essentially constant speed, require from six to ten horsepower each; drying machines, consuming from ten to fifteen horsepower on the average, frequently require a speed range of five to one; winders, taking about one horsepower, run without much speed variation under normal conditions of production; steamers, taking from two to fifteen horsepower, according to their size, require a wide range of speed on account of the fixing needs of different colors; soapers, taking fifteen or twenty horsepower each, vary greatly in speed in commercial service; calenders, taking fifteen to twenty horsepower each, are essentially constant-speed machines.

Recent inquiry into the applications of electricity in such establishments leads to the conclusion that the compound-wound direct-current motor has a field of special usefulness in such service, particularly for the heavy machines requiring large torque on starting, such as mangles, printing machines, calenders and starchers. Sparking does not add to the fire hazard, as in a mill where the air is impregnated with lint and dust. Speed variations in the motors do not affect the quality of the goods to anything like the extent found in cotton mills, where weaving and spinning must be carried on with extreme regularity of driving, and the question of material breakage does not enter the prob-

lem of motor selection. Induction motors of the wound-rotor type supply the large starting torque desired, but without going to considerable trouble, the speed control is probably much less satisfactory. Sudden load changes occur and as yet the alternating-current repulsion or commutator motor does not appear favorable for this service. Direct-current shunt motors will handle print-works service satisfactorily where the constant-speed machines are concerned, and in some cases it doubtless would pay to install alternating motors of a variable-speed type, or simple induction motors for the machines running more steadily. The publication of print-works experience with motors of different types is desirable.

ULTRA-VIOLET LIGHT FOR STERILIZATION.

The destructive action of ultra-violet light upon bacteria has been known for many years, but it is only recently that it has been employed upon any large scale for this purpose. The introduction of the quartz-tube mercury-vapor lamp furnished a cheap and convenient supply of the necessary radiation, and as a consequence this form of the mercury arc has been commercially applied to the sterilization of water and similar purposes.

Ordinary sunlight contains a considerable quantity of ultra-violet radiation, although the proportion is much less after it has filtered through the atmosphere to low altitudes than it is upon high mountains. This is due to the opacity of the air to these rays, a large quantity of the short wave-lengths being absorbed. Nevertheless, even at sea-level, sunlight has a strong bactericidal action, and this is a factor in the purification which flowing water is known to undergo.

The use of quartz in the mercury-vapor lamp serves a double purpose. In the first place, it is transparent to these rays, whereas glass, the material otherwise used, is comparatively opaque to them and transmits but a feeble quantity. In the second place, quartz will withstand a much higher temperature than glass and it is consequently possible to operate the lamp at a higher temperature. At the higher temperature the proportion of ultra-violet radiation to the total radiation is increased, and consequently more of this component is radiated per watt-hour expended in the lamp.

The action of ultra-violet radiation upon bacteria appears to be deadly and to be extremely rapid. Although certain bacteria can stand intense cold, they seem incapable of surviving exposure to the ultra-violet rays. It has been suggested that the first life may have been brought to our planet in the form of such microscopic organisms, the action of gravity upon which would be less than the pressure due to radiation; their emigration through space would be thus explained, and their resistance to cold seems unlimited. If such micro-organisms, however, resembled bacteria also in their susceptibility to radiation of short wave-lengths, none would ever have reached the earth alive.

ELECTRICAL CONDITIONS IN EUROPE.

That the condition of the electrical industry in Europe at the present time is more promising than in this country is evidenced by an article which will be found in this issue written by an American engineer who has just returned from a tour of that continent. He reports great activity not only in manufactures for domestic consumption, but also for export. The inference lies close that if American manufacturers made more effort to increase their export trade, the latter would help to tide them over periods of dullness in the home market.

Germany appears to be particularly active and successful in developing export trade, and its competition has reached such a point as to create considerable alarm in England, where discussions are taking place as to how export trade can be saved and developed for English manufacturers. Conditions in England do not seem so rosy as on the Continent. The Germans are deservedly notorious for their experimental work and seem to have carried this practice into the field of electrical engineering with excellent results. The development of new apparatus and new methods is ever being pushed forward and carries with it the benefits which invariably accompany such a policy. German manufacturers seeking foreign trade also receive more help through governmental and financial channels than in England or America.

The comparisons which are made by our contributor between practice in this country and in Europe in the fields covered is interesting and indicates that in most lines America has little to learn of her European rivals so far as the excellence of design and economy of construction are concerned. The rapid strides which have been made in this country in turbine work as well as in electrical machinery have placed us in a position where Europe can look to us for suggestions.

The statement that we are far behind in attention given to careful operation of machinery and power plants is one that should be taken to heart by American operators and efforts should be made to reach the same efficiency and attention to details of operation as is achieved in European plants. One handicap which may be met in this direction will be found in the higher wages that must be paid skilled attendants in this country than in Europe, and this undoubtedly is one reason for the relative conditions which are met in practice.

The disconcerting effects of metal lamps, which caused so much apprehension among the central stations of this country, do not seem to have been felt in Europe. In England, especially, it is reported that since the introduction of metal lamps new customers have been more easily attracted, and central stations have shown an almost universal increase in output. This condition is reflected, of course, in the profits of supply undertakings, which have been faring much better than the manufacturing interests.

Program of Convention of American Institute of Electrical Engineers.

As previously announced, the annual convention of the American Institue of Electrical Engineers will be held in Chicago, June 26 to 30, with headquarters at the new Hotel Sherman, Randolph and Clark Streets. All sessions will be held in the hotel.

No special transportation arrangements have been made for the convention.

A number of entertainment features have been arranged, including a reception for the ladies at the South Shore Country Club on Wednesday afternoon, June 28, and some automobile trips.

Arrangements have been made by the Convention Committee with a number of golf clubs in and around Chicago so that those desiring to play golf may have the privileges of the clubs during their stay in Chicago.

A tentative program has been drawn up and is given herewith. The sequence of papers and the dates assigned are subject to change.

MONDAY, JUNE 26, 9:00 P. M.

Reception and dance, Grand Ball Room, Hotel Sherman.

TUESDAY, JUNE 27, 10:00 A. M.

Power-Station Session.

President's Address, by Dugald C. Jackson.
Address by President-Elect, Gano Dunn.
Development of the Modern Central Station, by C. P. Steinmetz.
Tests of Oil Circuit-Breakers, by E. B. Merriam.
The Use of Reactance Coils in Large Central-Station Systems, by R. F. Schuchardt and E. O. Schweitzer.

2:30 P. M.

Visit to Western Electric and Commonwealth Edison Companies' plants.

8:30 P. M.

Electric Lighting Session.

Depreciation as Related to Electrical Properties, by Henry Floy.
Important Features Entering into Making of Appraisals, by H. M. Byllesby.

WEDNESDAY, JUNE 28, 10:00 A. M.

Railway Session.

Some Data from the Operation of the Electrified Portion of the West Jersey & Seashore Railroad, by B. F. Wood.
Analysis of Electrification, by W. S. Murray.
Solution to Problem in Sags and Spans, by W. L. R. Robertson.
Induction Machines for Heavy Single-Phase Motor Service, by E. F. W. Alexanderson.

2:30 P. M.

Industrial-Power Session.

Automatic Motor Control for Direct-Current Motors, by Arthur C. Eastwood.
Some Limitations of Rheostat Control, by T. E. Barnum.
Control of High-Speed Electric Elevators, by L. L. Tatum.
Electrically Driven Reversing Rolling Mills, by Wilfred Sykes.
Electric Vehicles, by P. D. Wagoner.

Telegraphy and Telephony Session (Parallel Meeting).

Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires, by George O. Squier.
Telegraph Transmission, by F. F. Fowle.
Commercial Loading of Telephone Circuits in the Bell System, by B. Gherardi.

EVENING.

Boat Excursion on Lake Michigan.

THURSDAY, JUNE 29, 10:00 A. M

High-Tension Transmission Session.

The Law of Corona and the Dielectric Strength of Air, by F. W. Peek, Jr.
Mechanical and Electrical Characteristics of Transmission Lines, by Harold Pender and H. F. Thomson.
Dielectric Strength of Air—II, by J. B. Whitehead.
Sag Calculations for Suspended Wires, by P. H. Thomas.
Transmission System of the Great Western Power Company, by J. P. Jollyman.
Transmission System of Southern Power Company, by W. S. Lee.
Transmission System of the Great Falls Power Company, by M. Hibgen.
The High-Efficiency Suspension Insulator, by A. O. Austin.
Electric Line Oscillations, by G. Faccioli.

2:30 P. M.

Visit to Indiana Steel Company's plant, Gary, Ind.
Conference of Institute officers and Sections delegates. (Under auspices of Sections Committee.)

FRIDAY, JUNE 30, 10:00 A. M.

General Session.

Economical Design of Direct-Current Electromagnets, by R. Wikander.
Electrolytic Corrosion in Reinforced Concrete, by C. E. Magnusson and G. H. Smith.
Wave Shape of Currents in an Individual Rotor Conductor, by H. Weichsel.
The Choice of Rotor Diameter and Performance of Polyphase Induction Motors, by Theodore Hoock.
The Application of Current Transformers in Three-Phase Circuits, by J. R. Craighead.
The Cost of Transformer Losses, by R. W. Atkinson and E. C. Stone.

2:30 P. M.

Educational Session.

Tentative Scheme of Organization and Administration of a State University, by Ralph D. Mershon.
Technical Education: Its Correlation with the Industries, by John Price Jackson.
Adjournment.

Railway Signal Association Meeting.

The summer meeting of the Railway Signal Association will be held at Hotel Astor, New York City, on June 13 and 14. There will be morning sessions from 10:00 a. m. to 12:30 p. m. and afternoon sessions from 2:00 p. m. to 5:00 p. m. The subjects for consideration include preliminary reports of all standing and special committees; a paper by W. K. Sparrow, entitled "Substitutes for Wood Trunking for Railway Signal Circuits," and a paper by W. K. Ferguson, R. E. Russell and E. E. Kimball, entitled "Apparatus for Charging Storage Battery."

Appropriation for Massachusetts Institute.

The bill granting $100,000 per year for the next ten years to the Massachusetts Institute of Technology, has been signed by the Governor of Massachusetts. The money appropriated is to be used for current expenses only.

Canadian Electrical Association Convention.

The annual convention of the Canadian Electrical Association will be held at Niagara Falls, Ont., June 21, 22 and 23. Headquarters will be established at the Clifton Hotel.

An interesting program of papers and entertainment features is being arranged, the latter including inspection trips to the water-power plants. Among the papers to be presented are the following: "Customers' Terminals," by Mr. Murray, New York; "General Accounting," by C. E. Bowden, Toronto Electric Light Company; "Ornamental Street Lighting," by T. F. Kelly, Hamilton Electric Light & Power Company; "The Two-Rate Meter Question," by P. T. Davis, Montreal Light, Heat & Power Company; "Relations of Public Service Companies to the Public," by B. C. McNabb, Montreal Light, Heat & Power Company; "New Business," by P. T. Kemble, Toronto Electric Light Company; "The Advantages of Publicity to the Central-Station Industry," by Glen Marston, Chicago; "Operating Safeguards," by E. Little, Kaministiquia Power Company, Fort William. Two other important papers will be: "Physical Data in Connection With Incandescent Lighting, Comparing Twenty-five Cycle With Sixty-Cycle Current," and "The Importance of Co-operation Between the Central Stations and the Electrical Manufacturers."

A feature of the program will be an address by Samuel Insull, of Chicago, on central-station work.

National Fire Protection Association.

The fifteenth annual meeting of the National Fire Protection Association was held in New York City, May 23, 24 and 25, at the Waldorf-Astoria.

In his opening address, President W. H. Merrill called attention to the terrible disasters which have resulted from insufficient fire protection, and to the work which lies ahead of the Association.

On the second day of the convention an address was made by Walter L. Fisher, Secretary of the Interior, on "The Fire Waste."

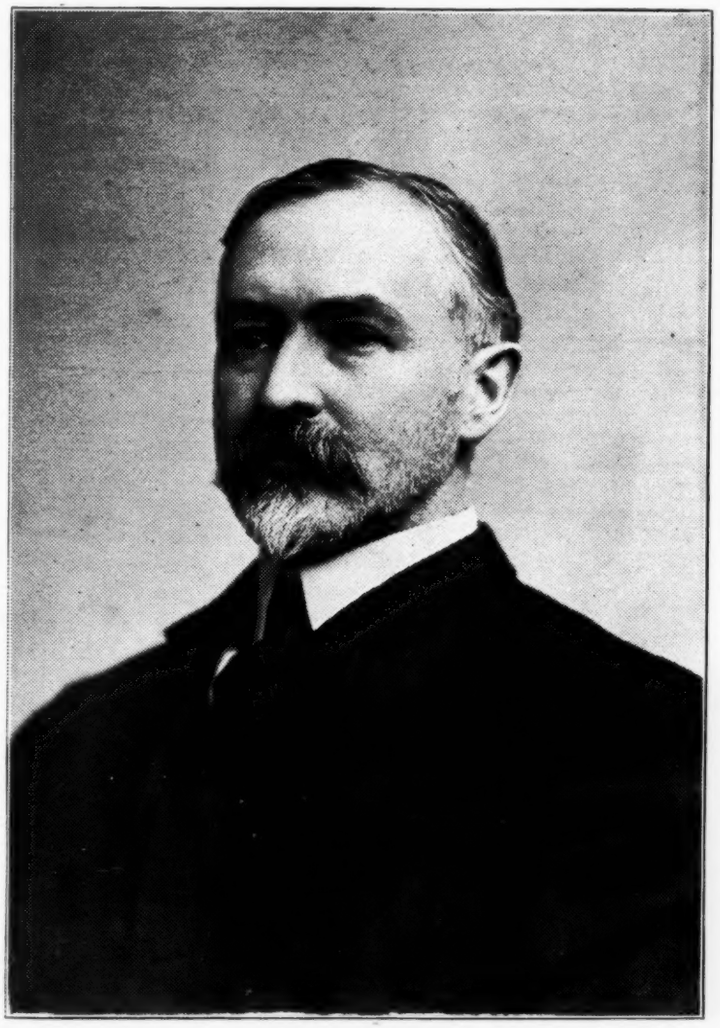
At the close of the convention the following officers were elected for the ensuing year: President, William H. Merrill; vice-president, C. H. Phinney; secretary and treasurer, F. H. Wentworth.

Alonzo Burt.

In conformity with the policy of the American Telephone & Telegraph Company to co-ordinate the various departments of its service, a very important announcement was recently made concerning the placing under practically one set of executives the five great telephone companies in Ohio, Michigan, Wisconsin, Indiana and Illinois. This group of properties includes the Michigan State Telephone Company, comprising the State of Michigan; the Cleveland Telephone Company, operating in the City of Cleveland and nearby counties in Ohio; the Central Union Telephone Company, operating in the remainder of Ohio, all of Indiana, and Illinois, except Chicago, and several nearby counties; the Chicago Telephone Company, operating in the City of Chicago and adjacent counties; and the Wisconsin Telephone Company, operating in the State of Wisconsin.

One of the prominent figures in this big telephone movement is Alonzo Burt, president of the Wisconsin Telephone Company, who becomes vice-president and treasurer of the five companies.

Mr. Burt's early years were employed in the Railway Mail Service, and he resigned in 1891 as Superintendent of the Railway Mail Service to enter the telephone business. He was first located at Omaha as special agent of the American Bell Telephone Company and represented that company as a director in the principal operating companies in the West. Later he moved to Kansas City and in addition to his work as special agent was general manager of the Missouri & Kansas Telephone Company. This company covered Missouri, except St. Louis, all of Kansas, Indian Territory and Oklahoma. Later Mr. Burt became president of the Missouri & Kansas Telephone Company and in 1902 was also made president of the Wisconsin Telephone Company. For the next three years he was president of both companies, but the two companies being widely separated involved a great amount of traveling and in the early part of 1905 Mr. Burt arranged to resign from the Missouri & Kansas Telephone Company and has since devoted all of his time to the affairs of the Wisconsin Company.



ALONZO BURT,
Vice-President of Five Large Telephone Companies.

Mr. Burt's headquarters will continue to be in Milwaukee, although he will now be associated with the activities of all of the five companies above mentioned.

Resistance of Insulators at High Temperatures.

The resistance of mica, asbestos board, sodium silicate, magnesium oxide, etc., has been measured by W. W. Stifler up to temperatures exceeding 1,000 degrees centigrade, and reported in the *Physical Review*.

After the initial heating, mica showed a falling off in resistance above 400 degrees and at 700 degrees has dropped to 10 per cent. After the test it was opaque and brittle.

Asbestos drops rapidly in resistance above 800 degrees. After the test it appeared to have lost its fibrous structure, and crumbled easily.

Sodium silicate breaks down very rapidly above 200 or 250 degrees.

Magnesium oxide is an excellent insulator up to 800 degrees. Above this temperature it becomes quite conducting, but recovers its insulating properties on cooling.

A patent compound known as cœmentium showed at first an improvement, but cannot be relied upon above 500 degrees.

The magnesium oxide seemed unaltered by the heat treatment. The sodium silicate and the cœmentium were baked hard, much like porcelain.

The specimens were heated in a platinum resistance furnace. The temperatures were read by means of a platinum resistance thermometer.

Engineering Education.

The membership of the Society for the Promotion of Engineering Education has reached 1,000. The Society is to be congratulated upon the fact that engineers of the highest standing are joining it in numbers. Non-teaching engineers are just as much concerned with the results of technical training as are those engaged in instruction. This Society has an important function in bringing together all persons concerned with engineering education.

Active preparations are now under way for the coming convention in Pittsburg.

San Francisco Telephone System Described Before Chicago Electrical Men.

At a joint meeting of the Electrical Section of the Western Society of Engineers and of the Chicago Section of the American Institute of Electrical Engineers, held at Chicago on the evening of May 24, Samuel G. McMeen, of McMeen & Miller, consulting engineers, Chicago and San Francisco, presented a paper entitled "Notes on a Telephone System Recently Built in San Francisco and Its Neighborhood."

Mr. McMeen prefaced his paper by recounting some incidents connected with the disastrous earthquake and fire which destroyed such a very large part of San Francisco about five years ago. He was called there to make a study of a telephone system for the Home Telephone Company, and spent practically four years in making the designs and constructing the plant, and the last year in supervising its operation.

The city of San Francisco has a population of about 465,000. With the cities of Oakland and Berkeley across the bay, the metropolitan area comprises a population of about 609,000. The three cities are equipped with an automatic telephone system divided into two main portions, that in San Francisco which is equipped with the two-wire system, and that in the transbay cities, which is built on the three-wire system. The two groups are connected by cable about eight and one-half miles long, of which three and one-half miles is submarine cable. Each of the two main sections of the system has a main exchange and four branch offices, with a number of subsidiary offices containing only the subscribers' line switches.

The franchise requirements that the company had to meet were rather severe, in that it was required that $2,000,000 must be spent on the plant in the first year, a total of $3,000,000 in the first two years, and $4,000,000 in the first three years; this made the first year's work very strenuous.

The climatic conditions of San Francisco are peculiar and one of the most severe problems was to make the system moisture-proof. This was done by using underground lead-covered cable for all of the main trunk and lateral lines, so that open overhead wire was used only for drop-wire purposes, and even that was insulated. The cables and conduit lines were laid out to care for estimated traffic conditions up to the year 1925. For the main conduit runs vitrified terra-cotta and bituminized wood fiber ducts are used. For the lateral conduits iron pipe is also employed. Much difficulty was experienced in laying all the underground plant on account of the destruction of all records of underground piping and conduit systems and considerable ingenuity had to be employed to find a place for the conduit in crossing many of the streets. A total of about 2,500,000 duct feet of conduit was laid. It is all laid with not exceeding four ducts in one layer and the number of ducts in the trenches varies from four to eighty. All ducts are surrounded by concrete to a thickness of about three inches. Concrete manholes were used exclusively. Where the duct enters these structures, holes were drilled for it by means of a pneumatic drill.

The sizes of lines and the cable equipment in general were so laid out that any two subscribers joined from the remotest stations to the central office are connected by trunk lines to secure an equivalent of about nine miles of standard cable circuit. All the lines are completely equipped with protective devices to divert foreign currents of all kinds. Where the cable terminals are connected to drop wires a new type of simple terminal was developed which makes the cables, which are paper-insulated throughout, perfectly hermetically sealed. The terminals are mounted on porcelain slabs which are assembled in a tubular box filled with sealing compound. Service connections were made in a neat and unobtrusive manner, largely in the rear of buildings. Particular care was taken so that it was possible to trace circuits in a simple and systematic way.

The exchange buildings are built entirely of fireproof construction and are designed with consideration both to the architectural effect and to permanency of construction and fitness for their purpose. Special care was taken to arrange the cableways throughout the buildings in the most orderly fashion. The operating rooms have cement concrete floors without covering of any kind except that they are treated with a special cement filler which prevents the abrasion of cement dust. Some of the subsidiary offices which contain line switches only were built out of unused vitrified, four-duct tile, thus securing a double air space. These offices are kept locked at all times and have no attendants whatever.

The direct-current energy at the central offices is obtained from twenty-three cell storage batteries, to which counter electromotive force cells are added during charge to maintain a constant potential of forty-six volts. No duplicate storage batteries are needed.

The bulk of the telephone lines are equipped with meters which record up to 10,000 calls and then repeat. Unanswered and busy calls are not recorded. These meters have worked very satisfactorily. Mr. McMeen touched on some of the features connected with the transbay service which is operated on the two-number system that is frequently used for suburban telephone business. Quite a few private-branch exchanges are in use in San Francisco. Many of these are entirely of the automatic type. A considerable number of apartment houses have been equipped in this manner, thus making it possible for any line to be used at any time of the day without requiring an operator at the private board. These private exchanges are equipped with a series of line switches which give access to relatively few trunk lines. The automatic equipment has given excellent service and met every one of the severe and varied conditions imposed on it.

The discussion of Mr. McMeen's paper was briefly participated in by Chairman J. G. Wray, W. Lee Campbell, Franklin H. Reed, Arthur Bessey Smith, DeWitt Tanner, E. H. Smythe, and Albert Scheible.

Illinois State Electrical Contractors.

The semi-annual meeting of the Illinois State Electrical Contractors will be held in Bloomington on June 16 and 17. The meeting will be held on two days, as heretofore the business has been too much to be disposed of in one day. The meetings and the headquarters will be at the Illinois Hotel.

New Tariff in Finland.

A new order has been issued by the authorities in Finland, according to which electrical machinery and apparatus weighing less than 2,000 kilograms will pay $9.16 per 100 kilos. When the weight exceeds 2,000 kilograms the duty is less.

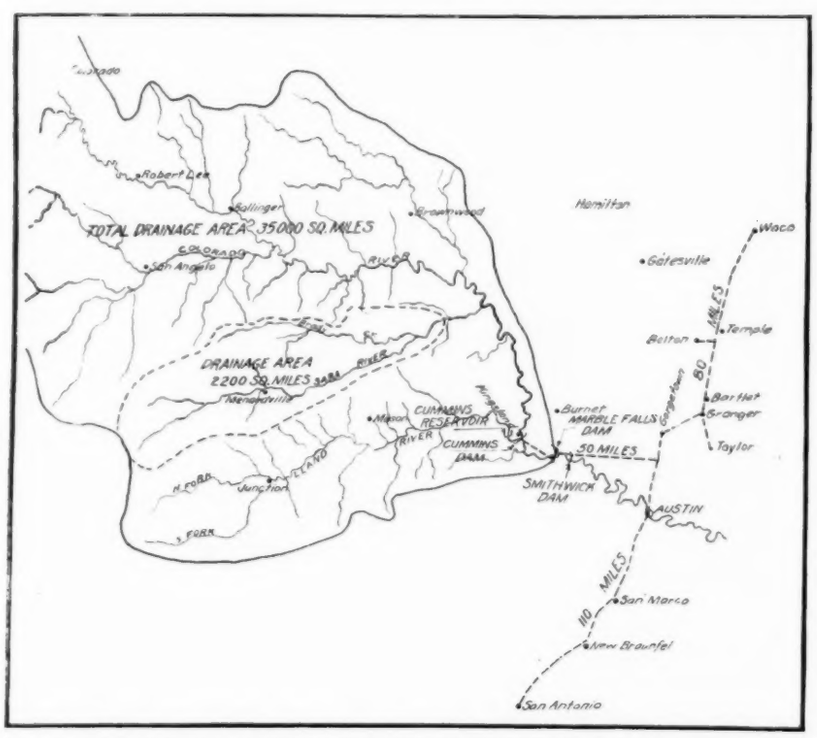
Hydroelectric Development on the Colorado River in Texas.

Marble Falls Plant of the Colorado River Power Company.

What is considered one of the most important hydroelectric developments in the Southwest from an engineering and commercial standpoint, is the work now under way and projected by the Colorado River Power Company at Marble Falls and other points on the Colorado River in Texas, which contemplates an installation of about 20,000 horsepower.

In 1909 work was started on the construction of a reinforced-concrete dam at Marble Falls, one of the best natural dam sites on the river, where three natural falls of a total height of fifty-three feet were submerged by the construction of a dam, making available a head of seventy feet. There are available on this river two other dam sites within a distance of twelve miles, the lower one at Smithwick Falls and the upper one at Cummins Dam, with available heads of 50 and 40 feet respectively.

Government data on the flow of the Colorado River are available for a period of fifteen years, from 1896 to 1910 inclusive, and show a flow ranging from an average minimum of about 250 second feet to a maximum of 123,000 second-feet, with periods of drought and flood about equally divided. The enormous variation of flow is to be overcome by the construction of a flood storage on the San Sabe River, a large tributary stream flowing into the Colorado above the three developments, where at a reasonable cost a storage approximately 116,000 acre-feet can be obtained. With this enormous storage available, it is estimated a constant minimum flow of 740 second-feet will be obtained at Marble Falls.



MAP OF TRANSMISSION LINES AND DRAINAGE AREA OF COLORADO RIVER PROJECT.

The estimated primary power output of the three developments based on the flow data of the past fifteen years is 56,325,000 electrical horsepower-hours, in addition to which there would have been available secondary power ranging from a minimum of 28,000,000 electrical horsepower-hours in 1910 to a maximum of 42,000,000 electrical horsepower-hours in 1900, averaging for the fifteen years, 35,000,000 electrical horsepower-hours per year. The power produced by these combined developments will be transmitted to the large cities and towns of Central Texas, Austin, Temple, Waco, San Antonio, and other cities as shown on the accompanying map. This map also shows the transmission lines and the area which constitutes the power market. It will be noted that power is carried forty miles to the southeast from Marble Falls to a point near Austin. From there the lines will run in northeasterly and southwesterly directions, terminating on the north at Waco and on the south at San Antonio, 110 and 80 miles respectively from Austin. The maximum distance of power transmission will thus be seen to reach 150 miles from Marble Falls. This transmission line will distribute the power ultimately developed in the comprehensive system embodying the three plants.

The company expects to sell the larger proportion of its power at wholesale to large consumers, a part of it having already been contracted for. On account of the high cost of fuel in this district, a market for the secondary power will be readily found with consumers now having steam power plants of sufficient capacity to supply their present needs, and during periods of low water a reciprocal agreement can be made with the steam-power-plant owners whereby water power will be used for their peaks and all surplus steam power available will be absorbed when required by the waterpower company, thus giving the steam plants a very desirable daily load-plans to retail its power at Marble Falls factor when in operation. The company and the smaller towns along the transmission line. A feature of the market is the fact that power for irrigation pumping and for operating cotton gins will be required during the season coinciding with that of the maximum flow of the river, thus giving a profitable outlet for secondary power.

The description of the development now under construction at Marble Falls, given herein, is quite typical of the proposed additional developments. The site upon which this dam is constructed seems to have been prepared by nature especially for the purpose. The main channel of the river bed at this point is about 500 feet in width and contains an abrupt fall of fifteen feet, and at the right bank just below the falls is a basin about 150 feet wide, forming a

natural pool for receiving the discharge from the water-wheel draft tubes. At a height of fifteen feet above the water of this pool the solid-rock bottom extends from the edge of the basin entirely across the river channel, the distance of 400 feet to the left bank thus making an admirable foundation for constructing the sluice-gate section of the dam. The saving in construction cost on account of the solid-rock bottom being at an elevation of fifteen feet above tail water, is apparent; of still greater importance, however, is the fact that the flood waters in discharging from the sluice gates are received on the down-stream side of the dam on this natural apron of solid rock, which gradually descends to the tail-water level, and when the sluice gates are closed, the entire down stream of this section of the structure lies high and dry, thus facilitating the inspection and maintenance of same. The entire river channel and banks are composed of a very hard limestone formation, the left bank rising almost perpendicular, while the right bank has a slope approximating forty-five degrees. The maximum length at the top of structure is 748 feet. The normal head created by the dam is seventy feet. The elevation of the highest point of the masonry on the sluice gate or spillway section being sixty-five feet, above which is a five-foot mechanically operated flashboard extending across the crest of this section a distance of 400 feet. This flashboard or movable crest is constructed in ten-foot sections, the frames being made of structural steel covered with three-inch lumber and secured at the top of the dam by heavy hinges; which hinges and joints between sections are made practically watertight by means of strips of heavy rubber belting. The ten-foot movable-crest sections can be raised or lowered one at a time by means of a portable hydraulic cylinder during floods.

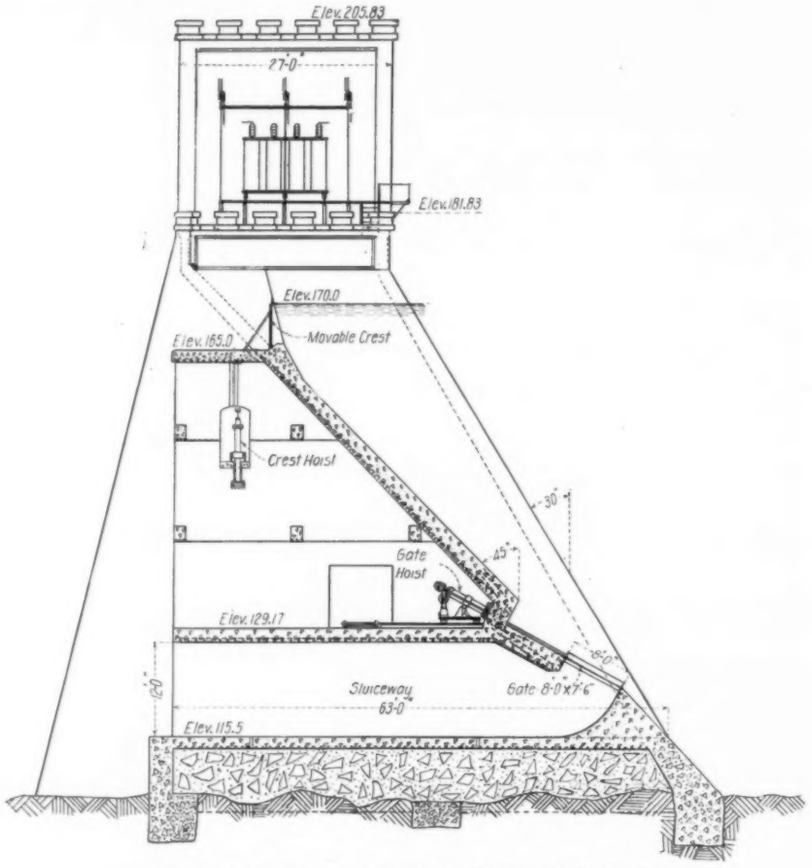
The entire dam, both sluice gate and power-house sections, consists of reinforced-concrete buttresses which support the reinforced-concrete bulkhead. The buttresses of the sluice-gate section are spaced ten feet between centers and in the power-house section, fourteen feet six inches between centers, except near the end of the sluice-gate section, where it was originally planned to omit sluice gates. There will be provided thirty-five sluice gates, each 7.5 by 8 feet, made of structural steel, the frames being composed of fifteen-inch channels suitably reinforced with six-inch channels so as to prevent deflection and also to prevent seepage between the concrete and the steel. The gates are built up of nine-inch channels and I-beams reinforced with tie rods and concrete and covered with a three-eighths-inch steel plate. Gates are operated one at a time by a portable hydraulic cylinder connected to the gates by stems or draw-rods extending through stuffing boxes.

The cylinder will be supplied with water pressure by a motor-driven pump located on the truck carrying the cylinder.

During floods it is planned to first put the sluice gates into operation and then, if necessary, any part or all of the movable crest can be lowered, or if desired, the surface of the pond may be allowed to rise and the surplus water flow over the top of the movable crest.

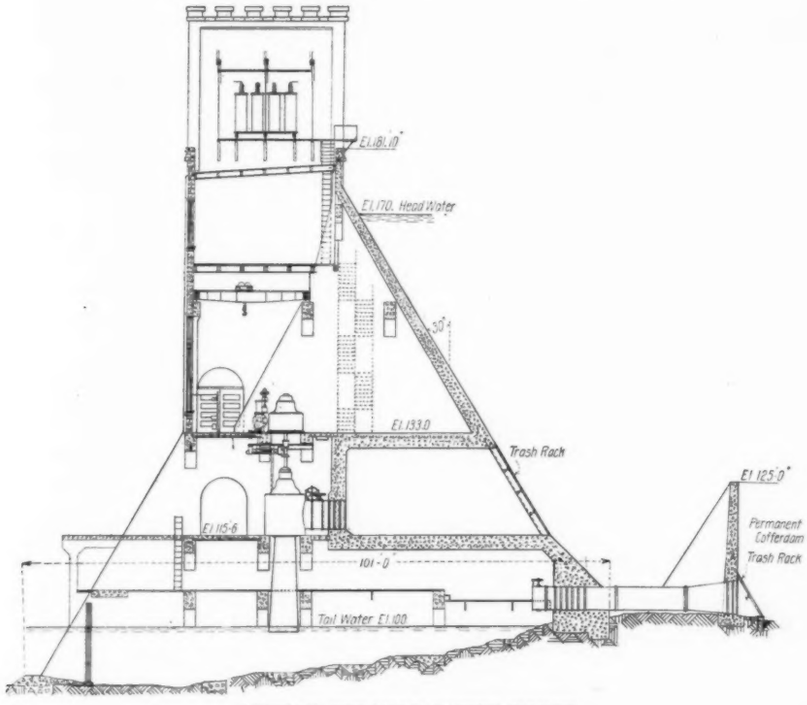
The maximum flood flow recorded on this river at this point is nearly 200,000 second-feet. This flow over an ordinary dam crest 350 feet in length would reach a height of about twenty feet over the crest. The capacity of each of the flood gates, with a head under which they are required to operate, is about 5,000 cubic feet per second for each gate, or 175,000 second-feet for the thirty-five gates. Therefore, it will be seen that a comparatively small volume of water will ever flow over the top of the dam.

The power-house section of the dam will be built to a height well above any possible high water. The maximum height from the foundations of this section to the top of the wire tower being 115 feet. The design of the power-house section differs from that ordinarily adapted in hollow-concrete dams in that the bulkhead of the power-house section is so designed that the machinery in the power house does not set directly below the bulkhead, thus avoiding any possibility of leakage or moisture affecting the electrical apparatus. This design also makes it possible to equip the plant with a suitable traveling crane, and furthermore avoids any possibility of damage to the foundations of the power plant by reason of the water discharging over the structure and into the tail race. The design adopted in this case also favors the installation of the high-tension apparatus in the power plant.



SECTION THROUGH DAM AND TRANSMISSION TOWER.

The power house consists of nine compartments, three of which will be occupied by the three 550-horsepower Victor vertical turbines direct connected to the 350-kilowatt Westinghouse generators now being installed. Each unit is equipped with a Lombard type A-6 oil governor. Five additional compartments will provide for future units of 2,200 horsepower each. One compartment will contain the high-tension transformers and switching apparatus. Generators installed are wound to operate at 2,300 volts, three phase, sixty cycles. For the long-distance transmission, the voltage will be stepped up to 66,000 volts. The present plans are to use wood-pole construction and eventually to install duplicate lines from the Smithwick Falls plant to Round Rock, the junction of the two main transmission-line branches. Details for the substation design and equipment have not yet been completed.



SECTION THROUGH POWER HOUSE.

One of the most unique features employed in the construction of this property is what the engineers who originated the idea are pleased to term the "dry-dock" system. This system consists of a permanent concrete cofferdam constructed along the crest of the natural fall just for the purpose of diverting the flow of the river through the sluice gates during construction, or later when making an inspection or repairs of the power-plant section of the dam. Three steel tubes extend through this permanent concrete cofferdam toward the power-house section, thence through the concrete bulkhead, and terminate in the discharge pits at an elevation slightly above tail water. These three tubes are each provided with cast-iron valves of the swivel-gate type, thus making it possible after drawing the water down in the pond, to divert the entire ordinary flow of the river through these tubes, and lowering the water in the pond to such an extent that the sluice gate section of the dam lies entirely above water. By providing a small drain or waste pipe, the space between the permanent cofferdom and the power house can also be drained into the tail race, thus making the upstream side of the power-house bulkhead and foundations entirely out of the water. Tail gates are also provided for each section of the power plant so that the water may be pumped from any compartment, thus making it possible to repair or inspect foundations at this point of the structure, and with this point accomplished, it will be seen that every part of this dam is accessible for inspection or repair without increasing the usual large expense for cofferdamming and the consequent long period of shut-down in case repairs are found necessary.

The prime mover in the organizing of this company is C. H. Alexander of Dallas, Texas, president of the Colorado River Power Company. The engineers in charge of the plans and construction are the W. H. Zimmerman Company, of Chicago.

Government Authority Over Water Powers.

A resolution has been introduced in the United States Senate by Senator Jones which directs the Committee on Judiciary to report in the next regular session of Congress, what the rights of the Government are as to the development of water power within the several states and calls for information as to whether the National Government has first, any authority to impose a charge for the use of water power developed on non-navigable streams, whether state or interstate; second, any power, in granting permits to develop water power on a navigable stream, to impose and enforce conditions relating to stated payments to the Government, regulation of charges to customers, and determination of the right to make use of such developed power?

And further, it inquires as to whether or not the Government has authority in disposing of any of its lands, reserved or unreserved, necessary or suitable for use in connection with the development or use of water power on a non-navigable stream, whether state or interstate, by lease or otherwise to limit the time for which such development may continue, or to impose and enforce charges for the use and development of such water power, or to control and regulate the disposition of such water power to its consumers.

Cable Rates Lowered.

The night-letter system recently adopted by the Western Union Telegraph Company is to be extended in the near future to cable companies doing business between this country and England. Arrangements have been made between the companies and Postmaster General H. L. Samuel, of Great Britain.

An announcement was made by the British Postmaster General to Parliament that a reduction of fifty per cent would be made on all non-code cable messages across the Atlantic, transmitted with the understanding that they should be deferred in delivery not longer than twenty-four hours.

The arrangement is the result of a campaign waged by Postmaster General Samuel and Theodore N. Vail.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

THIRTY-FOURTH CONVENTION, NEW YORK, N. Y., MAY 29-JUNE 2.

The thirty-fourth convention of the National Electric Light Association, held at New York City, May 29-June 2, opened auspiciously with a brilliant reception at the Hotel Astor on Monday evening.

The receiving party consisted of President and Mrs. W. W. Freeman, Vice-president and Mrs. John F. Gilchrist, Vice-president and Mrs. F. M. Tait, Gen. George H. Harries, treasurer, and T. Commerford Martin, executive secretary. The reception was held in the grand ballroom, accompanied by an organ recital by Arthur Depew, organist of Plymouth Church, Brooklyn, who rendered selections from Wagner, Grieg, Mendelssohn, Chopin, Seeboeck and Dubois. The reception was followed by a promenade concert on the roof garden, the program being furnished by F. W. McKee's Band, and including a grand march composed for the occasion and dedicated to the N. E. L. A. by the leader. Many old friends interchanged greetings and renewed former ties. The promenade concert was succeeded by dancing in the ballroom, music being rendered by McKee's Orchestra of fifteen pieces. A feature was a two-step, "Our President," dedicated by the conductor to President Freeman.

At 11 o'clock a collation was served in the orangerie of the hotel. The decorations of the hotel were unusually beautiful, electric welcome signs being in service at the main entrance and on the roof garden with a circular monogram sign above the receiving party in the ballroom. Many expressions of admiration were heard in connection with the use of colored electric lights in the illumination of the roof-garden flowers and fountains and the decoration of the sideboards in the orangerie by artificial electric flowers. The dance hall presented a brilliant scene, the contrast between the exquisitely gowned ladies and their escorts being most pleasing.

The reception was held under the direction of a sub-committee on entertainment headed by Frank W. Smith, the other members being F. C. Bates, T. Beran, C. L. Law, C. H. Macy, H. E. McGowan, C. W. Price and H. M. Wilson. Several past-presidents of the Association were present, including W. H. Blood, Jr., E. H. Davis, Arthur Williams, L. A. Ferguson, C. R. Huntley and F. W. Frueauff.

The attendance at the convention was marked and the registration on Monday afternoon totaled over 3,500.

Special trains and carloads of convention delegates arrived at local stations throughout Sunday afternoon and Monday. The largest trainload came in from Chicago Monday morning with 134 persons aboard. The longest special trip was that made by the St. Louis party, who occupied a couple of special cars attached to the Pennsylvania Railroad's "Twenty-four-hour New Yorker." A number of Bostonians journeyed to New York Sunday evening by boat, coming by the *Commonwealth* of the Fall River Line, which touched at Providence, taking on several local electrical men and thus bringing up to forty the total number of N. E. L. A. delegates aboard. Another large New England contingent followed Monday morning on the Bay State Limited train from Boston.

The Chicago train was run as a second section of the New York Central's "Twentieth Century Limited," leaving Chicago at 2:40 p. m. Sunday and reaching New York at 10:50 Monday morning. A special car was added to the train at Cleveland, bringing the total number of electrical delegates up to 134. At Elkhart, Ind., a stop of twenty minutes was made while those aboard the train alighted and had a group photograph taken, the ladies on the platform of the observation car furnishing an attractive background for the picture. Arrangements for the Chicago train were in charge of G. A. Freeman, of the Commonwealth Edison Company, who acted as assistant master of transportation. The Wagner Electric Manufacturing Company provided a printed directory list of those on board the special train, and presented the ladies with boxes of candy and the gentlemen with cocktails and cigars. The Minerallac Electric Company supplied badges, and the technical journals were not lacking in their attention to the travelers.

The St. Louis party left the Union Station, St. Louis, at 12:20 p. m. Saturday, and after an enjoyable, though dusty, trip reached the New York station platform precisely at 1:20 p. m., eastern time, making the 1,053-mile journey in exactly twenty-four hours of running time. In addition to the St. Louis people aboard several convention delegates from Illinois and Indiana points joined the train at stops along the line. Arrangements for the train were in charge of F. N. Jewett, of St. Louis, who acted as assistant master of transportation and canvassed by mail a large number of electrical men stationed in the St. Louis territory.

FIRST GENERAL SESSION.

Following the brief address of welcome to the city by the municipal representative, President W. W. Freeman delivered the annual address. Mr. Freeman outlined the work which had been accomplished during the year, and emphasized particularly the efficient efforts of the secretary's office and commended the diligence and faithful service of the Association staff. He called attention to the labors of the Public Policy Committee and the importance of the welfare proposals which would be made at a later meeting. The wish of the Accounting Committee was worthy of particular attention, and much had been accomplished in the standardizing of central-station accounting, the scheme outlined by the committee having been adopted by a number of member companies, and also by several public service commissions. An important matter now in the hands of the Executive Committee is the revising of the Code and establishment of a modern and practical method of resuscitation after electrical shock. This effort is being participated in by the Association of Edison Illuminating Companies, the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Electrochemical Society, American Electrotherapeutic Association, American Medical Association, and United States Navy Medical Department. Mr. Freeman said that the electrical industry attracted young men of fine fiber and that the opportunities were enormous. The record of of past achievement was but an indication and promise of future accomplishment.

Vice-president Gilchrist assumed the chair, and upon motion appointed H. M. Byllesby, Chicago; A. A. De Young, Ottawa, Canada; and General G. H. Harries, Washington, a committee to consider and report upon the president's address.

A number of announcements were made by Arthur Williams, chairman of the entertainment committee, who extended a cordial invitation to all to participate in all the good things planned for the convention.

H. H. Scott read the report of the Membership Committee. The present enrollment is as follows: Class A, 950; B, 6,654; C, 19; D, 226; E, 808; a total of 8,665. Activity has been particularly noticeable among the company sections, Chicago, Brooklyn, Boston, Philadelphia, and New York having made notable increases.

The report of the secretary, treasurer, insurance expert and the report of the Committee on Progress followed, without discussion.

REPORT OF INSURANCE EXPERT.

In his opening remarks Mr. Blood said that the resolutions passed last year at the St. Louis convention calling for lower average insurance rates have been beneficial, though the matter has not received the attention its importance warrants. He presented extracts from letters received from the Underwriters, in answer to these resolutions, showing that no attempt has been made to consider electric light and power risks in a class by themselves. Mr. Blood stated that an attempt has, however, been made to secure uniformity in rating by the Central Traction & Lighting Bureau. This organization in November, 1910, published a schedule with a base rate of eight cents in place of rates running from twenty-five cents to $1.25, each rating bureau having previously established its own base rate. Several other bureaus have adopted this new schedule and a reduction of approximately thirty-five cents has been brought about. In conclusion Mr. Blood mentioned the pending trial of the suit against a member company in Hobart, Okla., for $90,000 for alleged negligence in causing a fire in a department store. The trial is scheduled for December 5.

REPORT ON PROGRESS.

Mr. Martin's report on progress covered some ninety-six pages and, as usual, touched in a masterly way on practically all the important aspects of the central-station business. On account of the voluminous nature of the report it is impossible here to more than refer to a few of its many subheads. The report opens by an allusion to the splendid growth achieved in the last twenty-five years and the alluring prospects foreseen for it by some of the keenest electrical men of the time. Statistics of American central stations are given, showing a healthy growth in numbers despite consolidations. The present central-station investment in the United States is about $1,800,000,000 and annual gross earnings about $360,000,000. Development of the systems in Boston, Detroit, Duluth, etc., is referred to as significant of the great extension of electric networks. Comparisons are made with the conditions abroad, particularly in England, Germany, Austria, Belgium and Switzerland. Taking up questions of regulation, rates and franchises, Mr. Martin dwells on the federal corporation tax, the Cleveland suit against the lamp companies, right-of-way problems, valuations and rates and growth of public-service commissions. He touches on recent utterances respecting the conservation of water powers, and discusses briefly the rate situations in St. Louis, Los Angeles, Toledo and Montreal. Mr. Martin then describes the phenomenal development of the Commonwealth Edison Company's plants in Chicago, in the newest of which 20,000-kilowatt turbo-generators are being installed, these being the most powerful machines yet built. The best provision for carrying peak loads is considered and a number of new combination and straight hydroelectric plants described, including the 135,000-volt system near Au Sable, Mich., which will be put in service this year. A number of fuel problems are considered, particularly as to the availability of low-grade fuels in connection with gas producers. In illumination Mr. Martin touches on the tungsten-lamp situation, the lighting of a large New York department store, of the Allegheny County Soldiers' Memorial, of outdoor arenas, and of fire-alarm boxes. He also refers to developments in vacuum, mercury, quartz and non-tube lamps. Some suburban-town problems are exemplified by the practice of the North Shore Electric Company, of Chicago, and the need of central stations interesting themselves in the improvement of lighting conditions in small communities. Improvements in meter readings are discussed at some length, as well as the increasing use of controlled flat-rate systems, house-wiring problems, education of the public and particularly the householder to the value of electric service, licensing of engineers, education of public-utility employees, and many other topics.

A preliminary report of the Committee on Overhead Line Construction, and one of the Accounting Committee, were presented.

The paper entitled "Master and Men," by Paul Lüpke, was read by Mr. Martin.

MASTER AND MEN.

Mr. Lüpke's paper, like those he has been wont to present at the annual conventions of the Association, is a liberal and broad-minded commentary on certain important phases of his subject that are apt to be overlooked. In this paper he takes up some features of welfare work which formed such a prominent topic before the convention. The relations of master and men are not so clearly defined under modern industrial conditions as of old. In large corporations relatively few of the employees are acquainted with the head of the organization. This lack of intimate contact compels caution in the application of welfare plans. Great care is necessary in presenting them to the employees lest the latter consider them with suspicion. The men must be educated to the full meaning of the proposition, its object and its effect. Personal presentation of the plan, wherein the men are given an opportunity to ask questions regarding its details and to have them answered verbally and promptly, is much better than by printed announcements. This is even more necessary in profit-sharing schemes. Many men have no conception of the equity of such a system; they want their remuneration in hard cash every week, so that they may enjoy the fruits of their labor shortly after it is done. To overcome the feelings of prejudice and distrust will require patient and masterly educational work. Ideals are steadily being raised and humanitarian efforts are being appreciated and will ultimately prevail.

This paper was enthusiastically received and the first session was concluded with the presentation of an oil portrait of Miss Harriet Billings, assistant secretary-treasurer, on behalf of Henry L. Doherty, by W. C. L. Eglin, who made a graceful speech respecting the services which have endeared Miss Billings to the membership of the association.

It was then moved that a telegram be prepared and forwarded to Miss Billings expressive of the warm regard of the association. In seconding this motion Mr. Insull paid a delightful tribute to the faithful service of Miss Billings, as one who in the early days had found in her an able and diligent assistant. The meeting then adjourned.

The second general session was called to order by President Freeman at 2:30 p. m. The report of the editor of the question box was made by M. S. Seelman, Jr. He paid high tribute to the co-operation of executives in supplying information for the question box.

REPORT OF THE QUESTION BOX EDITOR.

Mr. Seelman's report calls attention to the great value that the Question Box is to the Association's membership in giving prompt and reliable information to inquiring members and in acting as a clearing house of general information regarding contemporary central-station methods and practices. The work of editing it is too onerous for a man who has his regular employment to attend to and it becomes a serious burden to the company with which he is connected. Therefore, Mr. Seelman recommends the selection of an assistant secretary to compile, edit and issue the Association's monthly *Bulletin*, including the Question Box and its related correspondence.

The report of the Committee on Question Box Revision was presented by Alexander J. Campbell, and was followed by the report of the Library Committee by Arthur Williams. The latter also presented the report of the Handbook Committee.

SOLICITORS' HANDBOOK AND LIBRARY COMMITTEE.

The reports of the Committee on the Electrical Solicitors' Handbook and the Library Committee are presented in one paper by Arthur Williams, who is chairman of both committees. The former report states that the increase in the Association's membership has necessitated another edition of the Handbook and while it will appear substantially as the previous edition, numerous changes and additions have been made.

The Library Committee reports that the increasing amount of literature being received by the Association makes it necessary to formulate some definite plans for a library and as there is already a technical library in the Engineering Society Building the committee recommends that the N. E. L. A. library be affiliated with the former, the Association to pay a small annual fee for purchasing books bearing directly on public-utility work.

After a lengthy discussion as to the best means for enlarging and distributing the handbook, the whole subject was referred back to the committee.

A paper on "Company and Company Section Bulletins," by E. H. Edkins, was then read. An abstract follows:

COMPANY AND SECTIONAL BULLETINS.

In this paper Mr. Edkins comprehensively reviews the origin, growth and possibilities of company and sectional bulletins. These bulletins are classified into three general divisions, first, bulletins issued solely for the purpose of advertising and increasing business of the central-station company; second, bulletins issued by the company sections of the N. E. L. A.; and third, bulletins published by member companies which are devoted exclusively to the affairs of the company and its employees, and are not directly affiliated with the National Electric Light Association. Speaking of company publications as a whole, Mr. Edkins quoted statistics showing the tremendous extent of this business in other industries and the benefits therefrom, while in the central-station industry only a few companies avail themselves of this opportunity for publicity and increased business. Considering the four principal house organs or bulletins published by lighting companies, coming under the first general division, Mr. Edkins gave cost data, circulation figures and other interesting data regarding each. The four publications mentioned were: *Electric City Magazine*, Chicago; *Chained Lightning*, Louisville; *Electric St. Louis*, St. Louis, and *The Edison Monthly*, New York. Mr. Edkins states that an analysis of the data received from the companies publishing the above bulletins would seem to warrant the conclusion that the company-bulletin idea as applied to the electric lighting industry, has been sufficiently successful to justify a wider application of this form of publicity.

Company section bulletins, according to Mr. Edkins, were suggested by the publication of the *National Bulletin*, the first issue of which appeared in 1907. Questions asked by Mr. Edkins of the editors of eight of these section bulletins showed the average monthly circulation to range from 275 to 4,000; the cost of publication to average from $54 to $300 and in every case the company paid the entire expense. Mr. Edkins spoke of the character of these publications and strongly urged their issuance by every company section.

There was a discussion by the chairmen of the various sections, the last speaker being Samuel Insull, of Chicago, who highly commended the fine spirit engendered by company sections and urged an interchange of bulletins, speakers, etc., between the various sections.

The Doherty Gold Medal, for the best paper presented before a company section, was awarded to Charles J. Russell, of the Philadelphia Electric Company, for his paper on "Load-factor, Diversity-factor and Power-factor," delivered in April, 1909.

On Tuesday morning there was a boat ride for the ladies on the Hudson River, and in the evening the entire convention party joined in a boat ride to Coney Island.

A report of the following days of the convention will be presented in our next issue.

TECHNICAL SESSION.

The first technical session was held on Tuesday afternoon, and was opened with the report of the Meter Committee by G. A. Sawin.

REPORT OF METER COMMITTEE.

This report describes the new meters which have been put on the market during the year and new apparatus for testing them. A satisfactory one-man test equipment possessing several novel features has been used by the United Electric Light & Power Company of New York. The outfit consists of two pieces, a portable rotating standard test meter combined with an indicating voltmeter, and a resistance load combined with a tool box. To eliminate the expense of a second visit if the meter reader fails to gain admittance, several companies have adopted a postal-card scheme. A return postal card is left at the premises and contains blank dials for the consumer to indicate the reading of the meter. As an alternative, the time may be filled in when it would be convenient to have the reader call. Every meter department should keep a record of the cost of setting and removing meters, testing, repairs, inspecting and reading meters, and other work connected with the department. The average percentage of accuracy is discussed and three methods given to determine it. The information is given from a number of companies who are using flat rates. The new legal requirements in the various states are chronicled. The report ends with a chapter of the meter code dealing with maintenance methods.

The discussion referred principally to the lubrication of meter bearings and the necessity for proper cupping of the jewels forming the bearings.

The report of the Committee on Grounding Secondaries was presented by W. H. Blood, Jr., and recorded the unanimous opinion of the committee that it is unwise to ground circuits higher than 150 volts.

REPORT ON GROUNDING SECONDARIES.

The Committee on Grounding of Secondaries reported that its year's work had been chiefly of an educational character. Practically everyone is agreed that secondary alternating-current circuits should be grounded. The only debatable point is to what voltage the grounding should be carried. A committee of the American Institute of Electrical Engineers advises 250 volts as the upper limit. The Association's committee, however, has steadily adhered to 150 volts, feeling that this is the maximum voltage that it is safe to handle at all times, and that if it were raised to 250 volts, accidents and fatalities are likely to occur. Moreover, with modern transformers and lightning arresters there is little danger of a transformer breaking down and charging any 250-volt wires with a higher potential. Such accidents would be much less frequent than those resulting from a continual ground on 250-volt circits. The Committee summarizes its opinion on this matter about as follows: Since the lighting customers predominate, protecting them takes care of at least seventy-five per cent of the central-station customers; more people handle lights than motors and the latter are generally under the care of persons versed in electrical matters, therefore, the users of lights are apt to be innocent victims in case of shock; lighting circuits have flexible cords, brass-shelled sockets, metal switches, and are less carefully installed and in many damp places, so that getting a shock is an easy matter. The Committee hopes to get data on the value of different kinds of ground connections, but is still convinced that metallic pipe grounds are the best and that plates and other ground devices are but makeshifts. The report concludes with some resolutions that were adopted by the Underwriters and which recommend that grounding be made mandatory by municipal departments, that it be recommended by inspection departments since it does not increase the fire hazard, that the National Electric Light Association see that all its member companies practice it, that grounding to waterpipes be urged, since it does no harm to the pipes, that other methods of grounding be thoroughly investigated, and that the American Institute of Electrical Engineers harmonize its limit of grounded voltages with that of the Committee.

Farley Osgood explained that the Fire Underwriters have not made grounding mandatory because the fire risk is not lessened.

Paul Spencer indorsed the opinion of the committee and stated that even 220 volts is too high for a grounded circuit.

A paper on "Grounding of Low-Tension Circuits as a Protective Measure" was read by P. M. Lincoln.

GROUNDING OF LOW-TENSION CIRCUITS.

Mr. Lincoln's paper indicates how, under certain conditions, comparatively high-voltage strains may appear between the low-tension windings of transformers and ground when these transformers are connected to a relatively high-tension transmission system. It has been noted from time to time that a breakdown will often occur on a low-tension circuit simultaneously with a disturbance on the high-tension side. Although there is no connection between the two circuits there are intimate relations between the appearance of voltage strains between low-tension windings of transformers and ground, and such disturbances as often occur on high-tension lines. The fundamental cause why breakdowns occurred so often on low-tension circuits simultaneously with disturbances on the high-tension side, is that transformers act to a considerable extent as condensers. The relative condenser capacities of high-tension windings against low-tension windings, and of low-tension against ground, may readily be determined with a fair degree of accuracy in any given transformer from the construction of the transformer. The greatest danger to the low-tension windings of transformers on disturbances on the high-tension side will take place when the low-tension windings are entirely disconnected from all circuits. Any attempt to overcome this difficulty by increasing the insulation of the low-tension windings is a step in the wrong direction. The remedy is through grounding of the low-tension secondaries. The condensers made up of the high-tension and low-tension windings of a transformer can under the worst conditions pass only a relatively small current. However, if this current is not taken off the low-tension windings, a high potential is bound to be developed thereon. Grounding the low-tension windings affords a path by which this condenser current may be taken off.

"Recent Important Improvements in Single-phase Motors" was the title of a paper by W. A. Layman.

SINGLE-PHASE MOTOR IMPROVEMENTS.

This paper describes the performance characteristics and construction of new forms of constant-speed and adjustable-speed single-phase motors now being manufactured. The constant-speed single-phase design has been based upon two fundamental principles, namely: (a) that good starting performance required the use of a commutator; (b) that the commutator must be relieved of duty upon attaining full speed, as in a squirrel-cage rotor. The main structural departure is in the rotor, in which two windings are employed. The principal wind-

ing is of the usual squirrel-cage type and occupies the bottom of the rotor slots. The auxiliary winding is of the commutated type, and occupies the upper portion of the slots. Between the two is a steel bar, forming a magnetic separator. Two sets of brushes are provided; one, in the axis of the main stator winding, is short-circuited; the other, normal to this axis, is connected in series with the stator winding while starting. Other details of construction are given. The adjustable-speed motor has been developed under the patents of Fynn, Arnold and La Cour. A motor was shown having six steps in speed between 750 and 2,250 revolutions per minute. The rotor is provided with a commutated winding and two sets of brushes, located as in the other motor. One set carries the working currents, the other the compensating and exciting currents. Regulation is secured through the stator windings. The power-factor is high. Curves are given showing the characteristics of both types of motor.

The session closed with a paper by F. D. Newberry on "Relation of Motor Load to Station Equipment."

ACCOUNTING SESSION.

The first accounting session was also held on Tuesday afternoon as a third parallel session. John L. Bailey presented the report of the Committee on Uniform Accounting.

REPORT ON UNIFORM ACCOUNTING.

The Committee on a Uniform System of Accounting reported that it had continually urged and again recommended the general adoption of the Association's standard classification of accounts. It had also considered the advisability of recommending the Association's system to public service commissions in states where no system has yet been adopted in the effort to have a uniform system in every state. The Committee sought permission to draw up a standard set of forms based on its system and to present those to member companies. It had also considered the establishment of a statistical bureau to gather data of value to all member companies and to act as a statistical clearing house between them. This was recommended and that a sub-committee be authorized to work out the details of organization of such a bureau and a means for meeting its expenses.

A paper was then read by R. F. Bousall on "Handling Customers' Orders." He described a method by which a customer's order may be taken by a solicitor either in the office or in his district—on the street, and told how to avoid duplication of work by the use of carbon copies and otherwise.

E. J. Bowers then read a paper entitled "The Collection of Bills."

COLLECTION OF BILLS.

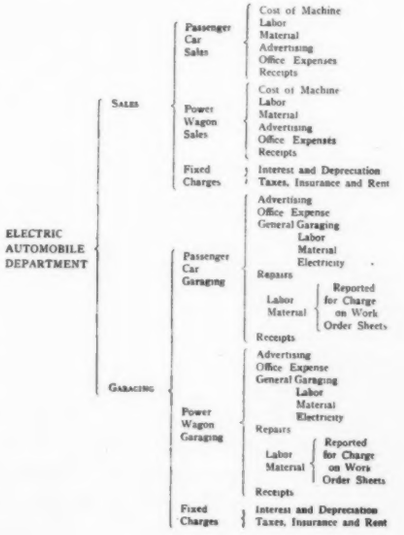
The early portion of Mr. Bowers' paper is devoted to a commentary on the collection of bills in general, with special reference to the discount allowed by various companies and rulings of legal and legislative bodies in this connection. Mr. Bowers states that the practice of appointing drug stores and express offices collection agents for the lighting company is not followed in Kansas City, due to the fact that a large percentage of the accounts are settled by check. Speaking of discounts the author states that the determining factors in arriving at what a discount should be are: (1) the discount must be much larger than that offered by mercantile institutions; (2) it should be simple and easy to figure; (3) it must be attractive to customers and large enough to induce them to pay during the discount period; (4) it must be taken into consideration in making rates and its effect on the revenue of the company must be anticipated. The object of such a discount is to decrease collection expense and reserve for bad debts, and to a certain extent increase the revenue of the company through discounts forfeited. The second half of the paper is devoted to a description of the collection methods of the Kansas City Electric Light Company. First, all contracts are passed for credit upon the approval of references. Collections of delinquent customers are handled by the card system. As soon as an account becomes overdue it is entered on a card and a letter is written to the customer advising him of the state of the account. This is followed up with a second letter which states that the service will be discontinued if payment is not made by a certain date. When this action becomes necessary a collector accompanies the trouble man and ninety per cent of the customers pay when they find service will actually be discontinued.

Mr. Bowers finds that the most economical and satisfactory method of handling collections is through the mail.

The last paper of the session was by Hermann Spoehrer and was entitled "Electric-Vehicle Accounts as Applied to a Department of a Central-Station Plant."

ELECTRIC-VEHICLE ACCOUNTING.

Mr. Spoehrer's paper deals with the system of accounting adopted by the Union Electric Light & Power Company, of St. Louis, in the conduct of the company's electric-automobile business. The St. Louis company engaged in the business of selling and caring for electric vehicles in 1907. Today the company operates an exclusive electric-pleasure-car garage in the residential section and an exclusive commercial-vehicle garage in the business section of the city. The rates for garage service on a standard type of pleasure car, having a battery equipment up to forty cells, is $30 per month, with an additional charge of $5 if the car is to be called for and delivered. This charge includes all service. For electric power wagons the rates are $45 per month for 1,000 to 1,500-pound vehicles, $50 for 2,000, 2,500 and 3,000-pound vehicles; $55 for 4,000-pound, $60 for 7,000-pound, and $65 for a 10,000-pound vehicles. In case of vehicles not regularly kept at the company's garage a charge of ten cents per kilowatt-hour is made for an individual battery charge. In addition to the Union Company's garage there are eleven other public garages caring for electric vehicles, revenue from three of these running approximately $5,000 each per annum. The general classification of accounts adopted for this business is shown in the accompanying chart.



Under the general heading "Passenger Car Sales" the cost of machine represents the cash cost f. o. b. the company's garage, including freight. "Labor" represents salesman's time and such labor applied at the garage prior to the sale of the car. "Advertising" includes all charges for billboard and newspaper advertising, pamphlets, etc., as well as current supplied to automobile signs owned by the company. "Office Expenses" includes the portion of light, heat, telephones and miscellaneous supplies properly chargeable to the sale of pleasure vehicles. The sub-divisions under "Power Wagon Sales" are in every way similar to those of "Passenger Car Sales." In the operation of a public garage, it is essential that careful and accurate data be always available, for the reason that it is indispensable in the settling of disputes arising from alleged mishandling of customers' cars. With this in view, the Union Electric Company has developed a system of record-keeping, the essential features of which are: a general charging sheet is kept, which shows the actual charging rate and voltage on every battery on charge in the garage during the twenty-four hours. A second record sheet is used to show the condition of each cell in every battery in the garage, this record being taken every ten days. A third record is in use for battery discharges.

A fourth record is kept showing the time each car in the garage leaves and returns, the odometer reading on each car, the days on which the car itself is washed, the days on which the battery is watered, the commutator inspected and the car is oiled and greased. Another record of great importance is the tire record. This shows the kind of tire, its number, the date applied to the wheel, which wheel it is put on, and the odometer reading on that date.

New Mexican Coke.

New Mexico has developed notably as a coke producer in the last five years. From a production of less than 90,000 tons in 1905, the output has increased to over 400,000 tons in 1910, according to E. W. Parker, of the United States Geological Survey.

The value for the 1910 product was $1,306,136. All of the coke made in New Mexico is from the coal mined in the Raton field, in Colfax County.

Tungsten in Nova Scotia.

Nova Scotia is becoming an important source of supply of tungsten. The demand for this metal has had an enormous increase since the advent of the metal lamp, and all available deposits of ore are being sought.

London Electrochemical Exposition.

The third Electrochemical Exposition will be held at Olympia, London, Eng., from September 23 to October 21, 1911.

Excursion of Washington and Baltimore Engineers to McCall Ferry Power Plant.

On May 21 the Washington and Baltimore Sections of the American Institute of Electrical Engineers, the Washington Society of Engineers and the Engineers' Club of Baltimore visited Holtwood, near McCall Ferry on the Susquehanna River, to inspect the great hydroelectric plant of the Pennsylvania Water and Power Company. A special train bore the excursionists, 198 men in all, to their destination and return.

A description of the McCall Ferry Plant was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for November 19, 1910, but a few words here in regard to this important enterprise may be of interest. A series of rapids in the river at this point made the development of power possible, and a number of years ago a company was organized for this purpose. A concrete dam, said to be the second largest in the world, was constructed at a point such that a series of islands in midstream just below could readily be made to form a natural tail race next to the east bank of river, the flow of water over the dam being now entirely diverted to the channel between the islands and west bank. The dam backs the river up for about eight miles, and in addition to expending about $1,250,000 to relocate the tracks of the Pennsylvania Railroad so that they would not be submerged, the Power Company found it necessary to purchase large tracts of land along the river on both banks, in order to protect itself against claims for damage due to the raising of the water level.

The forebay and concrete power house are at the east end of the dam, the latter being designed for ten large units. Extraordinary precautions were taken in the design of the forebay and power house to eliminate interference from ice, with the gratifying result that during last winter—the first season during which the plant has been in operation—no ice from the river found its way into the forebay, and none of the ice which formed there found its way into the wheels.

The water wheels and generators are of the vertical type, two turbines being mounted upon the same shaft. The I. P. Morris Company of Philadelphia built the turbines, the generators were furnished by the General Electric Company and the contractor for the installation was the Empire Engineering Corporation. The equipment at the Baltimore substation was furnished by the Westinghouse Electric & Manufacturing Company. Thus far, the only customer is the Consolidated Gas, Electric Light & Power Company of Baltimore, but it is understood that a contract will probably soon be made with the United Railways & Electric Company of that city. The right of way and transmission line is held in the name of the Susquehanna Transmission Company, which is merely a subsidiary of the Pennsylvania Water & Power Company.

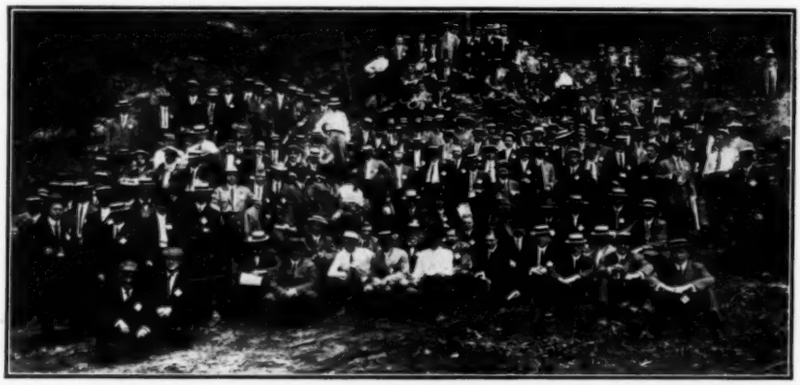
The statistical data in the accompanying table give a good idea of the magnitude of the enterprise.

The visiting engineers were favored with fair weather and were shown every attention by the power company. John Abbet Walls, chief engineer, met the party at the railroad station, and assisted by eleven other gentlemen associated with the company, he conducted them in groups over the entire plant, the hydraulic, the mechanical and the electrical features being examined in detail. The guides assisting Mr. Walls were F. A. Allner, assistant chief engineer; J. H. Smeaton, operating superintendent; Dr. J. Armstrong, resident physician; L. H. Eichelberger, construction engineer; William F. Mulcahy, local agent; E. E. Haslam, civil engineer; H. A. Harman, United States chief special agent; A. Benson, electrical engineer; A. Bang, electrical engineer; G. Vogt, hydraulic engineer, and W. P. Baker, mechanical engineer.

A group of the visitors is shown in the illustration.

DATA OF McCALL FERRY PLANT.

Length of dam, feet	2,350
Height of dam, feet	55
Width of dam at base, feet	65
Available head, feet	63
Maximum flow of river during 1903-1904, second-feet	309,300
Mean flow of river during 1903-1904, second-feet	43,199
Minimum flow of river during 1903-1904, second-feet	5,840
Ultimate length of power house, feet	500
Ultimate number of units	10
Ultimate maximum output, horsepower	135,000
Number of units now installed	5
Rated capacity of generators, kilowatts	7,500 and 10,000
Weight of revolving field of generator shaft, and the two wheels forming a unit, pounds	375,000 and 400,000
Frequency of three-phase generator current, cycles	25
Voltage of three-phase generator current	11,000
Voltage of line current	70,000
Length of transmission line No. 1 to Baltimore, miles	40
Width of right of way, feet	100
Number of steel towers	500
Length of span crossing Susquenhanna River, feet	2,000
Number of three-phase circuits	2
Size of stranded aluminum conductors, circular mils	300,000
Present capacity of substation at Baltimore, horsepower	40,000
Ultimate capacity of substation at Baltimore, horsepower	80,000
Voltage of secondary current delivered to customer in Baltimore	13,000
Capacity of step-up and step-down transformers, kilowatts	10,000
Cost of temporary concrete bridge used in construction of dam	$400,000
Total capital expended, approximately	15,000,000
Date of placing plant in operation, October 14, 1910.	



GROUP OF ENGINEERS ON VISIT TO McCALL FERRY POWER PLANT.

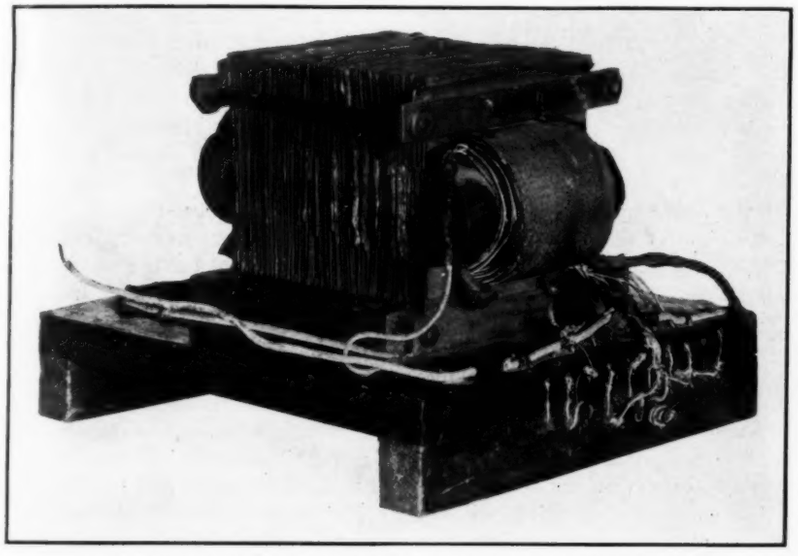
Denial of Isolated-Plant Service Extension.

In a decision recently made public at Boston, the Board of Gas and Electric Light Commissioners of Massachusetts has refused to permit a prominent Worcester retail merchant to build a conduit and lay wires across an important street in order to supply a portion of his establishment with electricity generated in his isolated plant. Some time ago the local Board of Aldermen passed an order granting the right, the avowed purpose of the petitioner being to confine the distribution of electricity to his own store exclusively. The Worcester Electric Light Company appealed from the municipal order on the ground that it legally opened the way for an extensive block supply in the center of the business section. The Commission's published decision sustains the company on all counts, points out that the policy of the state is against allowing two supplies in the same territory so long as one fulfills

its duties, and contends that the franchise granted could hardly be drawn so as to confine the sale of electricity to specified parties. In this way the block plant is obliged to content itself with service inside the inclosing street limits.

Stanley's First Transformer.

At the fourth annual dinner of the Pittsfield Section of the American Institute of Electrical Engineers, the guest of honor was William Stanley, and the dinner was made a celebration of the twenty-fifth anniversary of his construction and first commercial application in this country of the static alternating-current transformer. A report of this dinner was published in our issue of May 13.



FIRST COMMERCIAL TRANSFORMER, BUILT BY WILLIAM STANLEY.

We are now enabled to publish an illustration of this early transformer, which has such great historical interest. Mr. Stanley has presented this original transformer to the American Institute of Electrical Engineers, and it will be placed in the museum of the Institute, where it will form one of the priceless relics illustrating the history of electrical development in this country. As chairman of the Historical Museum Committee of the Institute, T. C. Martin accepted the transformer and took it into his custody.

Exports of Copper.

Exports of copper for the week ended May 18 were 6.692 tons. Since the first of May the amount was 16,702 tons. The figure given for the same period last year was 12,121 tons.

WATER POWER AND CONSERVATION.

ADDRESS BEFORE CHICAGO ELECTRIC CLUB.

Water power and conservation was interestingly discussed at the May 24 meeting of the Chicago Electric Club in a very comprehensive paper on this subject by I. E. Brooke, of the Rosencrans Engineering Company, Chicago. The paper was presented by C. E. Freeman in the absence of Mr. Brooke.

The paper treats of the significance of conservation and presents statistics showing the possibilities of water-power development yet to be realized.

The economical utilization of natural resources is probably the most fundamental problem of all engineering work. The responsibility then rests with the engineer in the education of the general public. The economical use of natural resources is something that should be considered by every engineer. The development of water power will save an enormous amount of coal, which is now used for transporting coal across the country. When it is considered that it takes approximately one ton of coal to haul a ton of coal across the continent, the great amount of fuel that is used in this way can readily be appreciated.

Conservation, in the highest degree, can be carried out by proper protection of forests, stopping the useless waste of them, and proper methods pursued in the development of our coal mines and oil and gas fields; and, also, in using the natural sources of power, such as coal, gas and oil, with the highest degree of efficiency. If we are able to construct our power plants in such a way that we can realize one horsepower-hour from each pound of coal where formerly we have been getting one-half hour, we are conserving our natural resources to a very great extent. This may be done by the consolidation of power-producing interests and is the logical solution, if these interests are properly controlled, or prevent unreasonable monopolies.

The paper quotes the remarks of Henry L. Doherty, indicating that approximately 33,500,000 horsepower in water power, which can be economically developed, is not yet utilized, while the country uses annually more than $200,000,000 in fuel that might be saved by the development of the water powers.

The only methods of producing power that are as yet commercially employed is through the use of coal, gas, oil and other fuels. From present knowledge these exist only in limited quantities and with the continuation of the present rate of use of these resources, a rate of consumption must soon be reached where, if continued, our natural resources for the production of power will be exhausted in a comparatively short time.

The present estimated coal consumption in the United States is from 480 to 600 million tons per year. If we assume a price of $2.00 per ton, this amount would represent a cost of from 960 million to a billion dollars. These figures do not include the value of oil, gas or wood which we all know are consumed in great quantities.

It is further estimated that in the United States more than thirty million horsepower are available in water power and when storage reservoirs are provided, this figure could be increased to 150,000,000 horsepower, some reports of the United States Government give the latter figure as 200,000,000 horsepower.

Taking the figures of thirty million horsepower, this would be equivalent to burning at least 200 million tons of coal, if all the power were generated in efficient plants of large size. Allowing for small and inefficient plants and their relatively poor economy, it is probable that 600 million tons of coal would be required to equal this amount of power. This is fifty per cent in ex-

cess of the total coal production during the year 1906.

The total development of the United States is 5,356,680 horsepower developed by approximately 52,800 wheels, or an average development of about 100 horsepower per wheel. The north Atlantic division of the United States has the largest water-power development, having a total installation of 1,700,000 horsepower. The region including the St. Lawrence River and Great Lakes has a development of approximately 1,000,000 horsepower. New York state has the largest water-power development, the total being 885,000 horsepower. This includes the Niagara powers on the New York side. California has a total or 446,000 horsepower. The average installation being about 435 horsepower per wheel. This figure is much larger than the average for the entire United States.

In considering the water-power developments of the United States, the paper states that an important factor is the value of forests as a means of regulating stream flow. A number of conclusions are stated which seem to indicate that under average conditions, the forest may have a tendency to produce more uniformity in the stream flow, but for extreme conditions during either flood or drought, the forest does not provide any capacity for minimizing the extreme conditions.

The paper states that the efforts of Government administration, both State and National, have so far been very largely misdirected in regard to water-power developments. In glancing over the different laws and regulations that have been proposed, it would seem that the tendency is to obstruct proposed water-power developments rather than to encourage them. All State and Government regulations with the exception of proper control for public-service corporations should be done away with. This would tend to encourage developments in every way.

Concerning the policies that the Government has adopted in regard to the payment of a tax for the development of water powers, Mr. Brooke states that one of the foremost hydraulic engineers in the United States correctly states that the policy tends to defeat the development of water power in general, having drawn his conclusion partly from the fact that the present difficulties in financing good water-power developments have been due to the above Government policies.

The industry of hydroelectric developments is yet in its infancy. As a rule the greater number of hydroelectric properties have not returned to the investor excessive profits. Hydroelectric projects are profitable or unprofitable according to the expense of the development, and the cost of maintenance and operation together with the demand for such power. The industry is subject to the same conditions as many other industrial developments, and does not involve a much greater risk.

Water power is almost a natural monopoly due to the laws of governing such a development. Electric transmission of water power has changed the entire conditions in the last few years. When industrial developments of this nature were limited to some particular locality, no reason existed for a combination of developments. With the increase of knowledge in the science of electrical transmission of power the conditions make the consolidation of power developments almost imperative. The demand for power is no longer limited to the local mills, but spread over a large territory. With this increasing demand it is only natural that the operating companies should extend their developments so as to make use of the energy of several sizes of several streams, and it is only fair to assume that a common administration properly controlled will be more valuable to the ultmiate consumer than competition in the same field. The economies effected by the consolidation of power development is too well understood by most engineers to be questioned in any way.

By the development of water power the enormous consumption of our natural resources can be lessened if not wholly prevented, and in utilizing this source of energy we are taking something that is being wasted by non-use. There has been a good deal of agitation in the last few years concerning the destruction of forests and the wasting of our natural resources. There has been a great deal of good accomplished by the agitation of the subject and there has also been some things accomplished that have not been for the good of the greatest number.

One very important consideration in connection with the present system of government control is that the limited tenures are applied only to the power generating station. When the situation is looked at in a broad manner, it is obvious that the generating station in itself is of no great value, for without the transmission and distribution system, the generating station would be of little use. It is not uncommon in hydroelectric developments to find an installation where the transmission and distribution systems represents an investment many times greater than the generating station. The longer the transmission lines and the larger the distribution system, the greater the investment and the greater number of people served.

Lewis Institute Branch, American Institute of Electrical Engineers.

The annual business meeting of the Lewis Institute Branch of the American Institute of Electrical Engineers was held on the evening of May 26 at Lewis Institute, Chicago. The meeting was preceded by a dinner, at the conclusion of which Prof. P. B. Woodworth acted as toastmaster. After a number of extemporary addresses, officers were elected for the ensuing year, as follows: Ralph Kilner, chairman; H. N. Gilbert, vice-chairman; A. H. Fenshott, secretary. The meeting was then adjourned to the auditorium, where Samuel G. McMeen, of Chicago and San Francisco, delivered a delightful illustrated address on "The Electrical Engineer and the West."

Mr. McMeen touched particularly on conditions in California, where the scarcity of both labor and coal has hastened the development of many hydroelectric systems. From these, electric power is now extensively employed in agriculture, especially for electric pumping. Irrigation is bringing about the utilization of enermous tracts of arid land. About San Francisco there has been considerable electrification of railroads. Mr. McMeen paid a tribute to the wonderful civic spirit shown in the rebuilding of the city since its destruction by earthquake and fire five years ago. He then described briefly the automatic telephone system of San Francisco, Oakland and Berkeley, whose design, construction and operation had engaged his attention for the last five years. A description of this system is given on other pages of this issue in the summary of Mr. McMeen's paper on this subject.

ELECTRICAL PROGRESS IN EUROPE.

ITS MESSAGE OF ENCOURAGEMENT FOR AMERICANS.

BY C. A. TUPPER.

"The deeper the insight we obtain into the operation of Nature's forces," said Werner Siemens, some years ago, "the more we are convinced that we are now standing only in the vestibule of science—that an immeasurable field still lies before us."

This, summed up in a single sentence, is the attitude of Europe towards every branch of the electrical industry. To an observer from America the spirit of investigation, of research, of practical experiment to be met with on every hand, as he journeys from one industrial center to another, is very impressive. Hardly less so is the evidence of increasing material progress, to be found in manufacturing, in power plant, railway and line equipment and in the multitude of commercial activities now dependent upon or promoted by this most modern of agencies.

During a tour of the Continent and parts of England, embracing every industrial district of importance west of Russia and north of Buda-Pesth, from which I have just returned, I witnessed a degree of activity at almost every point that contrasted strongly with the depression prevailing at home. The larger plants were working two long or three short shifts per day; many of them were behind on deliveries, and the demand, both for domestic use and export, seemed to be steadily increasing. With it all, too, there was evidence of conscientious care in filling every order, of attention to detail and of a desire for the steady improvement of the output, which was like the smooth, well ordered running of a vast machine.

Apart from its local bearing, however, the situation has in it much of encouragement for Americans, for at least three reasons, viz.:

(1) Following so closely upon a period of great industrial depression of strikes, lock-outs and other disturbances, and in the face of an upward swing in the cost of raw materials and labor which has had no parallel in Europe, the present flowing tide of prosperity is a prophecy of what may be expected in this country in the not-far-distant future. Moreover, it has taken place despite low prices for the finished products, extremely small margins of profit and the necessity for the radical readjustment of many important elements in both the manufacture and use of electrical equipment.

(2) With all the enormous progress of the last few years in the principal countries of Europe, the application of electricity to every phase of industrial service, to the use of communities or districts and to domestic economy has not been nearly so general as in the United States and Canada. The exceptions to this rule will be stated below. Taking the entire field of application, therefore, we have in our own land, per unit of population, a much greater foundation for the future upbuilding of the electrical industries. It is this that we must utilize. It is this that we can utilize.

(3) Notwithstanding the advanced character of some of the designs now being worked out abroad, particularly for special apparatus, our American average for standard machinery or appliances is, in my judgment, higher than that of any European country; and our methods of production, handling, etc., are more economical, whether figured upon the basis of efficiency of equipment and labor or of net returns upon capital invested. In determining that point I was aided by a very thorough investigation which I made, for a specific purpose, of the use in foreign shops of American machine tools and other wood or metal-working equipment, as compared with similar machinery of European make; so this view is not put forth without a rather detailed knowledge of many of the essential facts.

With the above in mind, let us review, briefly, recent European accomplishments and consider present tendencies abroad in various lines of electrical development.

No feature of the situation has greater interest than the systematic utilization of hydroelectric power in districts where its development can be profitably undertaken, either on the basis of local consumption or for transmission to distant points. With the chains of mountains that occupy the center of Western Europe and radiate outward, the opportunities for the use of high heads are numerous, and most of the noteworthy plants of recent design have been constructed under these conditions. Their output is taken for electric traction lines or distributed to interior manufacturing centers. In the South the coast cities, such as Naples and Marseilles, are also beginning to share in the benefits of the new system.

Greater attention than formerly, however, is now being paid to low-head developments. Until with the last few years the designing of hydraulic turbines had not reached a point where such plants were sufficiently dependable from the standpoint of commercial efficiency; for drought or flood time brought such variations in the working head as to seriously reduce the operating efficiency of the turbines; but recent installations have shown that it is now practicable to design wheels for heads as low as two or three meters which will yield satisfactory results under as widely varying conditions as are likely to be encountered in the same locality.

To Americans there is much of encouragement in the fact that, whereas our own early engineering of hydroelectric plants was based almost entirely on Swiss experience, the tide has lately set in the opposite direction. During the closing years of the nineteenth century and the beginning of the twentieth, so many plants were built in the United States, Canada and Mexico under unusual conditions of service, that generally higher standards of efficiency were developed here than in any other part of the world, and our distinctive types maintain their lead. In one of the largest of European works for the manufacture of hydraulic turbines, which I visited, it was frankly admitted that every important piece of work on the floor was modeled upon American lines. The claim, however, was made, and apparently with reason, that in working out their efficiency curves the calculations were more carefully executed than is usual in this country.

Among the companies foremost in turbine building are the F. W. Strobel Aktien Gesellschaft, Chemnitz; Maschinenfabrik Geislingen, Geislingen; Maschinenbau Aktien Gesellschaft, Golzern; and Briegler, Hansen & Company, Gotha, Germany; Theo. Bell & Company (Kriens), Lucerne; and Escher, Wyss & Company, Zürich, Switzerland, the last named being well known in this country for the machines

installed by them at Niagara Falls and elsewhere. They have units now in the shop that are destined for British Columbia and South America.

One feature of this business which differs from American practice is to be found in the number of concerns which independently manufacture runners and other turbine details. It is claimed that, by making a specialty of these, they relieve the turbine builders of much expensive development work and are able to put through standard parts in large quantities at less cost. The point is worth consideration by some of our leading turbine manufacturers. Prominent in the production of such parts is the Aktien Gesellschaft Oberbilker Stahlwerk, Düsseldorf, Germany. At the same place are located the engineering works of Hartung, Kuhn & Company, who have taken first rank in the designing of speed and pressure regulators, governers, etc., for prime movers, compressors and pumps of all kinds.

An interesting sidelight on the displacement of steam by hydroelectric power for districts in or near the mountains is thrown by the fact, reported to me in Switzerland, that there has been a heavy falling off in the demand for lubricating oils, the best grades of which have heretofore been supplied mainly from America through the European affiliations of the Standard Oil Company.

The use of internal-combustion engines operating on blast-furnace gas, which was originated in Europe, goes on apace, and is now being supplemented to an increasing extent by the installation of gas-producer units. Over wide stretches in Northern Europe, particularly in Germany, where neither furnaces nor water powers exist, the use of lignites and other cheap fuels in gas producers is one solution of the problem of securing low-priced power. In respect to gas engines, comparison of the best European makes, such as the Nuremburg, with American types is again to our advantage. The high-grade engines built in this country by Allis-Chalmers Company, the Westinghouse Machine Company, Buckeye Engine Company and others, are generally simpler in construction, require less attendance and are more reliable in their operation. With regard to coal consumption, the differences in fuels make comparison as difficult as it often is between installations in various parts of the United States; but at many European plants, on a British-thermal-unit basis, the difference would appear to be against us. In other words, we build good engines but bestow less care on their operation. The same is true of producers. I did not find any abroad that seemed to me better than the Westinghouse, Muenzel (Minneapolis Steel & Machinery) or Wood types, but there was none treated with the carelessness that I have observed in this country.

The action of the Hamburg-American line in fitting one of its new trans-Atlantic steamers with oil engines has been followed with a great deal of interest abroad, and considerable thought is being given to the development of that type of marine propulsion. While at Cologne I was also told that the Gasmotoren-Fabrik-Deutz, whose works I saw just across the river at Deutz, had evolved a type of gasoline engine, up to 500 horsepower, for use in vessels towing cargo barges on the Rhine.

By reason of the close study now being given to the combustion of coal under boilers, and particularly in the burning of low-grade fuels, a new lease of life has been extended to the building of steam-driven plants in places where the European tendency would otherwise be to rely upon gas engines or hydroelectric power transmitted from a distance.

Independently of this, however, the designing of steam turbines, both for land and marine service, has shown remarkable development of late. For alternating-current work the numerous builders, under license or patent, of the Parsons, Curtis, Zoelly, Rateau, Bergmann and Melms & Pfenninger types have produced standard machines of noteworthy efficiency, with corresponding improvements in the low-pressure and combined high-and-low-pressure units. The tendency is towards more moderate speeds, greater strength of materials, better insulation for high-voltage coils, more effective ventilation, and radical improvements in rotor design. In the line of turbo-generator units for direct current, up to say 2,000 kilowatts, European builders have met with considerably greater success than any in this country, and quite a number of such units are now in service. Taking the types in the order above mentioned, it seemed to me that Brown, Boveri & Company, whose headquarters are at Baden, Switzerland, had the best display of turbine work in their shops. The machines most closely resembled those of the Westinghouse companies in this country and differed from those of the Allis-Chalmers Company principally in the methods of inserting and protecting the blading, having no shroud ring on the periphery. In the works of the Allegemeine Electricitäts Gesellschaft, of Berlin, and those of Escher, Wyss & Company, at Zürich, I saw notably good examples of impulse-turbine construction, the former being similar to that of our General Electric Company. The Maschinenfabrik Oerlikon, Zürich, is the licensee for several countries of the Rateau turbine, controlled in this country by the Western Electric Company. Other leading turbine builders on the Continent, besides branches of American concerns, whom I found represented by installations, are the Osterreichische Dampf-Turbinen Gesellschaft, Vienna; Elektrizitäts Aktien Gesellschaft, Prague; Maschinenbau Aktien Gesellschaft, Prague; Erste Brünner Maschinen-Fabriks Gesellschaft, Brünn, Austro-Hungary; the Gutehoffnungshütte, Oberhausen; J. A. Maffei, Munich (München-Hirschau); Maffei-Schwartzkopfwerke, near Berlin; Sächsische Maschinenfabrik, Chemnitz; and Maschinenfabrik Augsburg-Nürnberg, Nuremberg, Germany; and Franco Tosi, Legnano, Italy. Marine turbines are being turned out by some of the above and a number of others, including the Turbinia Deutsche Parsons Marine Aktien Gesellschaft, Berlin, and F. Schichau, Elbing, Germany. With the work of the leading English turbine manufacturers the readers of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN are already so familiar as to require no further comment here.

A specialty is being made by alloy manufacturers of blading for turbines, the Aston Chain & Hook Company, Limited, of Birmingham, England, represented on the Continent by Hy. Bergerat & Company, Paris, having done some notably good work in this respect. Their material has been used for the blading of the turbines on the Cunard liners and for the best examples of English, French and Italian turbine-driven war vessels.

I heard a good deal, while abroad, in relation to a new type of steam en-

gine which is the invention of Professor Stumpf, well known in this country; but he was absent from the Royal Technical High School, at Charlottenburg, the only time I had to call there, and I learned no authentic particulars concerning this machine. Nor did I see one operating. The engines that I found in service were mainly those of moderate capacities installed in the power houses of industrial plants. They appeared, as a rule, to be well constructed; but I was not interested in making any close comparisons with American designs.

In viewing the auxiliary equipment of steam-driven plants, such as pumps, heaters, condensers, etc., I received the impression, wherever I went, that American manufacturers could improve upon much of what was installed; but some of our types, such as the Westinghouse-Leblanc condenser, were represented by apparatus built by branch companies or under license in foreign shops. European station engineers also appeared to be getting very efficient service from equipment of almost any kind, as a result of their scrupulous attention to operating detail. The refinements of American power-plant practice, such as mechanical stoking, have not gained much of a foothold abroad; but, with the increasing cost of labor, these will probably be necessitated in time.

The design and operation of electric generators, rotary converters, large motor-generator sets, boosters, frequency changers, etc., have proceeded along very much the same lines in Europe as in the United States. In general, tendencies are about as noted in the foregoing with respect to turbogenerators. It is, however, decidedly worth while for any American having a practical interest in the manufacture of electrical machinery to inspect the work of the best European shops. With all the flow of information and ideas which we have had from abroad, there are many details still to be gained.

For alternating-current work synchronous motors in the larger sizes are used in place of induction motors to a rather greater extent than in the United States or Canada, and with beneficial results. To operate mine hoists, cranes, unloading machinery, compressors, blowers, etc., where variable speed is required, there has been developed a single-phase commutator motor, taking polyphase current, which is very efficient and better adapted to this purpose than most of the motors designed for similar service in the United States. Another special motor of the single-phase repulsion type has previously been in use for textile-mill and other service. The speed of either can be varied by simply shifting the brushes. The standard induction motors manufactured abroad give no evidence of being any better than American machines, say the Fairbanks-Morse or Crocker-Wheeler types, or those of any other leading manufacturers of the United States that have previously been mentioned in this review. The same is true of direct-current motors, except some highly special types. An increasing tendency, however, is to be found in the use of interpole construction for both motors and generators.

The development of power transformers has been parallel to that of the standard American designs, such as the Wagner, Pittsburgh, or General Electric, high efficiencies and almost absolute reliability having been attained in Europe as well as here. Equally good lighting transformers can also be obtained on both sides of the Atlantic; but the use of the latest improved types is not so general abroad.

Manufacturers of cables for long-distance power transmission, as well as subaqueous communication by telegraph or telephone, have been experimenting with new methods and material which are currently reported abroad to have yielded some remarkable results; but I was not sufficiently versed in this line of work to get the full benefit of the information given me. I was, however, confronted on every hand with the evidences of progress in wireless communication. Stations for both commercial and military use are being everywhere established; along the coast elaborate arrangements are being made for signaling to vessels the approach of storms, and in aeronautics the new system is playing a prominent part. The agreement recently entered into between the Marconi and conflicting wireless interests will materially facilitate progress. Much is also anticipated from the experiments to be made with the new 100,000-volt wireless station on top of the Eiffel tower in Paris.

For electric systems of all kinds particular attention has been paid by European engineers to the designing of switchboards, to improved methods of line construction, where wires or cables are used, to protective apparatus, insulation, current control, etc. In respect to these details some of their systems are marvels of ingenuity, showing, also, the utmost nicety of calculation. But, in the broad field of controlling electric currents for industrial and commercial use, Americans have outstripped foreign experts. In that regard I could not find that Europe had any equivalent for the work of the Cutler-Hammer Company, of my own city. This was gratifying to local pride.

An arrangement of peculiar interest, which has come into use in Europe to some extent, is the connecting of neighboring plants, separately owned, to run in parallel, with consequent interchange of power. This proves particularly advantageous if the peak loads of the one come on during certain hours of the day and the maximum of current is required by the other at night, when both plants would, under any circumstances, need to be continuously operated. In one place I learned of a gas-power plant and a steam plant which had been thus coupled. The idea has in it much of suggestive value for the owners of power plants in this country which are within easy transmission radius. Something similar is to be found in the use of power generated at South Chicago and Gary in a single circuit which includes the Illinois Steel Company, Universal Portland Cement Company and Indiana Steel Company.

American Museum of Safety Chartered.

A special charter has just been granted to the American Museum of Safety by the Legislature of New York. Among the trustees are E. H. Gary, Philip T. Dodge, James Speyer, Thomas Lynch, Arthur Williams, Edson S. Lott, Frederick L. Hoffman, George F. Kunz, Charles Kirchhoff, T. C. Martin, Charles A. Doremus, Louis L. Seaman, Frederick R. Hutton, William H. Tolman.

The exhibits at the Museum include protective devices for the safeguarding of human life in almost every field. The collections are of intense interest and value to the manufacturer, for, at present, in the United States, over 500,000 men are wiped annually out from the ranks of the wage earners.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XXXIII.

TYPICAL HYDROELECTRIC PLANTS.—IV.

BY W. B. GUMP.

PLANT OF THE GREAT NORTHERN POWER COMPANY.

An example of distant diversion is well illustrated in the plant of the Great Northern Power Company at Duluth, Minn. A map of this development is shown in Fig. 18. The hydraulic works comprise a canal, a forebay, and a pressure pipe line. In this development a portion of the fall along the St. Louis River is utilized, the final development contemplating two or more separate stations.

The St. Louis River and its tributaries drain an area of 3,700 square miles in the northern part of Minnesota, thus creating a valuable source for the development of hydroelectric power. A peculiar hydraulic feature of this region is the fact that in a distance of 150 miles the total fall is 1,150 feet without any falls or rapids occurring within these limits which are available for diversion. On this account it was necessary to locate the plant further down, and at a point where the available working head is 378 feet, being made up of a series of rapids which give a total head of 464 feet in a distance of eight miles. The pipe-line loss is, of course, considerable, in a developement of this character.

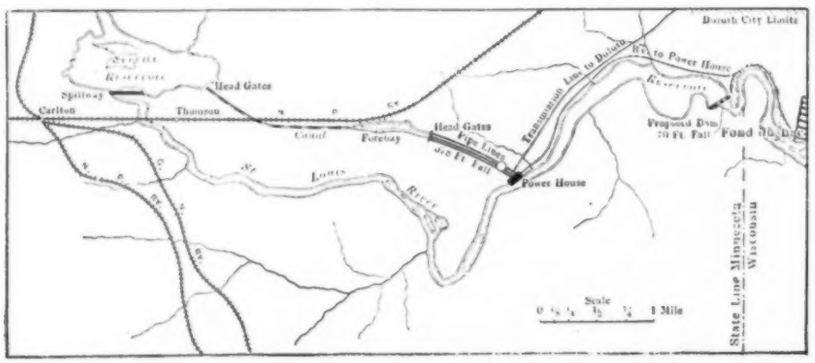


FIG. 18.—MAP OF GREAT NORTHERN POWER COMPANY'S DEVELOPMENT.

One of the most important features of this developement is the excellent opportunity for lake storage. The reservoir near the village of Thomson, 464 feet above Lake Superior, has a gross capacity of 130,000,000 cubic feet of water. This furnishes an ample supply for both storage and regulation.

One unfortunate feature is that the flood flow is about 100 times the minimum flow during a dry year, making the problem of properly handling of the water a serious one. The main dam is constructed of concrete, and is 1,120 feet in length. The spillway section is 368 feet long, 38 feet high and 42 feet wide at the base.

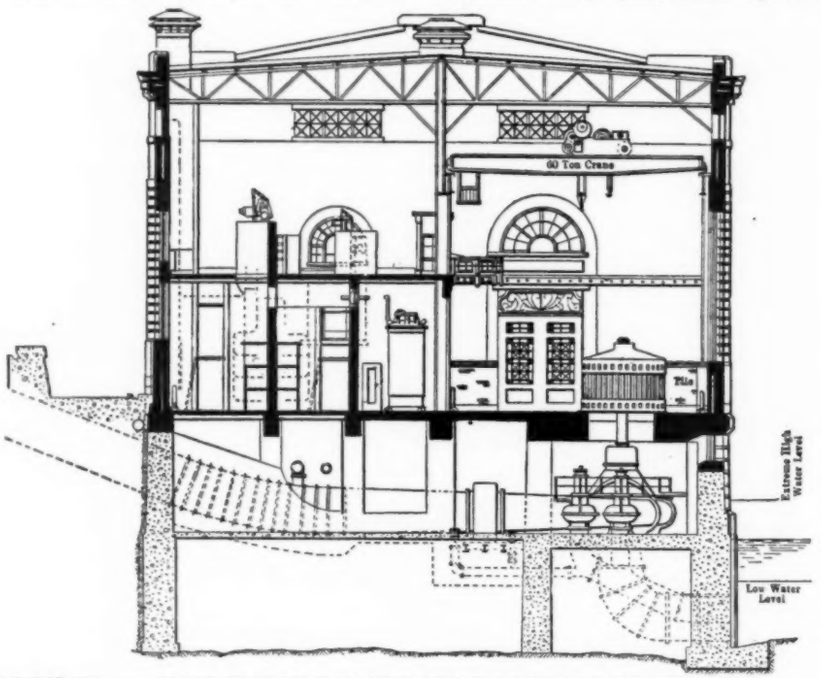


FIG. 19.—CROSS-SECTION THROUGH GREAT NORTHERN POWER PLANT.

The service reservoir is valuable as an agent for the elimination of needle ice. It is said by those in authority that no needle ice or anchor ice has been observed at any time. This is surely a record to be envied by power companies in various parts of the country. The service reservoir discharges into the forebay through submerged arches, forming a curtain wall which gives the water a low velocity.

Fig. 19 is a cross-section of the power station, completed scarcely more than four years ago. Its design was based upon an ultimate capacity of about 80,000 horsepower. Water is conveyed from the forebay through wooden-stave

pipe lines, extending to the penstocks which are constructed of plate steel, amply riveted and dipped into asphaltum before being placed in their final position.

At a point above the power station the pipe lines are joined by a cross receiver. A standpipe six feet in diameter extends from the top of the receiver to a tank thirty feet in diameter, the general construction of which is shown

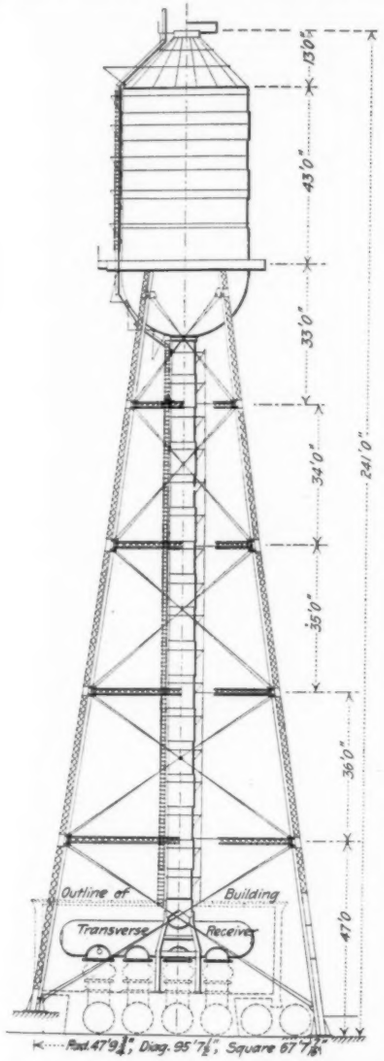


FIG. 20.—STAND PIPE AND SURGE TANK.

in Fig. 20. This acts as a surge tank, and evens the pressure arising from sudden changes in the load.

The present installation comprises four units, each consisting of a 13,500-horsepower vertical reaction turbine connected to a vertical twenty-five-cycle three-phase generator of 7,500-kilowatts capacity. The generators are rated to carry a twenty-five per cent overload for three hours. The potential at the machine terminals is 6,600 volts between phases. The ultimate capacity of this station is to embrace four additional units, doubling the present capacity.

Exciting current for the main generators is furnished by two 125-volt exciters, of 250 kilowatts each, connected to vertical 500-horsepower impulse turbine. Either exciter will furnish current for the eight units which the station is to contain ultimately.

The thrust bearings are of sufficient interest to deserve a brief description. These bearings are supplied with oil under pressure, each turbine having an individual oil pump. The pumps are of the two-stage type, each stage being designed to bring the oil pressure up to 200 pounds per square inch. Thus a total pressure of 400 pounds per square inch is available if desired. Each oil pump is driven by means of a Morse roller-bearing chain connected to a sprocket mounted upon a jack shaft which is geared to the main unit. A central supply tank is used for the suction side of all pumps. The delivery side discharges into a closed receiver located beneath the basement floor. One set of pipes lead from this receiver to the respective thrust bearings, while a second pipe leads to the oil cylinders of the operating mechanism connecting the turbine guide vanes. The oil drip from the bearings and the discharge from the cylinders are cooled by means of water-cooling coils surrounding a receiver to which the oil is conveyed. Cooling water is furnished from the penstocks.

The main substation for the distribution of power is located at Duluth, a distance of fourteen miles from the plant. The transformers in the generating station are three-phase, 7,500-kilowatt, oil-insulated, and are provided with taps for transforming to 30,000 and 60,000 volts respectively, to accommodate future power requirements at points 70 to 100 miles from the station.

The present transmission system is of steel-tower construction, the distance between towers ranging from 300 to 1,000 feet. The towers vary in height from forty to sixty feet, depending upon topographical requirements. The method of protection against lightning consists in suspending a grounded steel cable in a position above the line conductors. The telephone-station booths are insulated, to eliminate danger from high tension.

PLANT AT CENTERVILLE, CAL.

The power station at Centerville, Cal., is a typical high-head, distant-diversion development. The chief point of departure from accustomed practice is the adoption of Francis turbines, the effective head in this station being 565 feet.

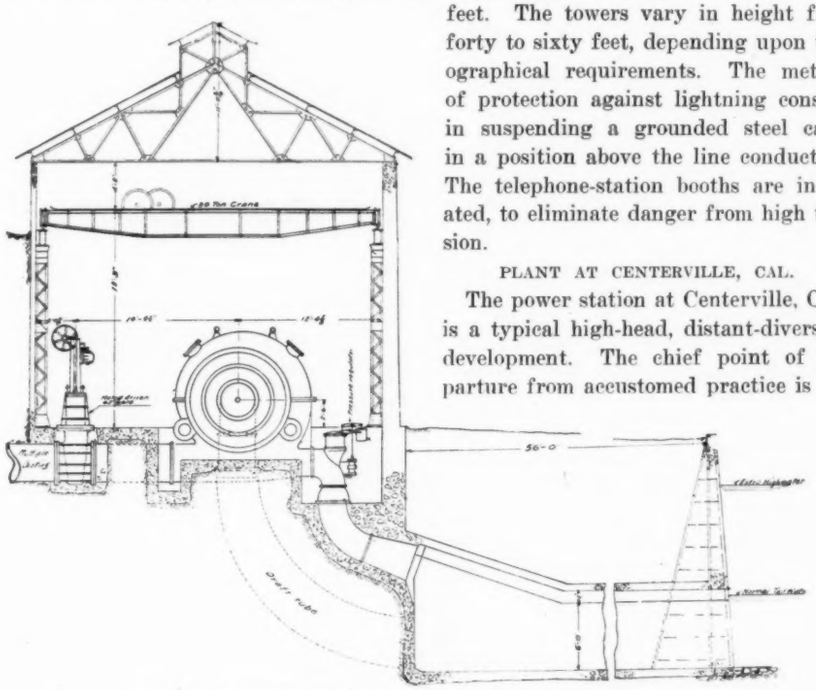


FIG. 21.—CROSS-SECTION THROUGH CENTERVILLE PLANT.

The Centerville station is but one of eleven hydroelectric plants embraced in the system of the California Gas & Electric Corporation. The original installation in this plant consisted of one 900-kilowatt and two 400-kilowatt units. The latter have been replaced by a single unit of 5,500-kilowatt capacity, which occupies substantially the same floor space as the original units.

It will be noted in Fig. 21 that the turbines are horizontal and of the radial inward-flow type, having a single axial discharge. The spiral casing is constructed of cast steel and has a quarter-

turn discharge to the draft tube. A pressure regulator is also provided. There are twenty-four pivoted guide vanes connected to a cast-steel speed ring which is designed to increase the velocity of the water gradually to that required by the guide vanes. Lombard governors are used for controlling the gates.

The 5,500-kilowatt generator is a three-phase, sixty-cycle, 2,400-volt machine, running at a speed of 400 revolutions per minute.

There are six 840-kilowatt, shell-type, oil-insulated, water-cooled transformers. Cooling water is supplied under a head of fifty feet. High-tension lines operating at 60,000 volts lead out of the building.

(To be continued.)

[EDITOR'S NOTE.—This important series of articles was started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and before its conclusion will cover every phase of central-station design.]

Spontaneous Combustion of Coal.

The spontaneous combustion of coal has been investigated by Parr and Kressman, whose results are given in the *Journal of Industrial and Engineering Chemistry.*

They show that oxidation processes begin as soon as the coal is taken from the mine, and that when the temperature produced by external factors reaches a certain point, auto-oxidation sets in, and results in the ultimate destruction of the coal. The average temperature for auto-oxidation lies between 200 degrees and 275 degrees centigrade, according to the state of division of the coal, while ignition takes place at about 350 degrees.

The factors contributing to raise the temperature of the coal to the stage of auto-oxidation include: (*a*) external sources of heat, such as sunlight, or impact due to the method of unloading; (*b*) fineness of division; (*c*) readily oxidizable compounds of a bituminous nature; (*d*) iron pyrites, the presence of as little of which as five per cent may raise the temperature by about 70 degrees centigrade; (*e*) moisture, which promotes the oxidation of the pyrites; (*f*) oxidation of carbon and hydrogen, which takes place at temperatures above 120 degrees to 140 degrees centigrade; (*g*) the fourth or autogenous stage of oxidation.

Any measures to prevent spontaneous combustion must be based upon a consideration of these facts. All external sources of heat must be eliminated as far as possible, and all dust or finely divided material separated. Complete dryness in storage will prevent oxidation of iron pyrites, which is a fruitful source of danger in coal from the Central West. No system of sorting at the mine can eliminate all risk from this source. Drenching the coal with water may increase the chances of oxidation where the sulphur is distributed throughout the whole mass, while complete submersion of the coal will probably not prove practicable. Preliminary heating might be used to bring about the initial stages of oxidation, and thus eliminate some of the factors which would subsequently supply the necessary heat for destructive oxidation processes. Treatment with chemical agents does not promise much; but a system of circulating cooling liquid through pipes distributed throughout the mass appears more promising. On the other hand, the formation of air-passages, which is frequently advocated as a remedy, seems likely to do as much harm as good, since the heat of the oxidation promoted by the access of fresh oxygen may more than counter-balance the heat carried away by the air currents.

The New Minneapolis General Electric Station.

Work is progressing rapidly on the new generating station and substations for the Minneapolis General Electric Company, Minneapolis, Minn., to replace the station which was destroyed by fire on January 7, and it is expected that it will be completed some time in October.

The new generating station will be located on the east bank of the Mississippi River where it is intersected by Twenty-ninth Avenue, this point being near the northern limit of the city. The building, 120 feet by 160 feet, will be handsome in appearance and will be built in accordance with the most modern practice in central-station design. Through the courtesy of the engineers we are able to present a reproduction of the wash drawing of the station as it will appear when completed. The building will be absolutely fireproof, the construction being of steel and concrete with terra-cotta trimmings.

The interior of the plant is divided into an engine room and boiler room, being 80 feet by 120 feet in size. The steam-generating equipment will comprise ten 600-horsepower Babcock & Wilcox water-tube boilers supplying steam at 180 pounds working pressure. The steam will be superheated 125 degrees by Foster superheaters. Provision is made for coal storage bins of large capacity and an elaborate equipment of coal and ash-handling apparatus will be installed. The stack will be of standard construction 200 feet high and thirteen feet six inches in diameter.

The boiler-feed pump installation is to consist of turbine-driven centrifugal pumps, the turbines being of the Terry type direct connected to Janesville pumps.

The generating equipment will comprise two 6,000-kilowatt Allis-Chalmers turbo-generators generating current at 2,300 volts, which will be stepped up to 13,200 volts. For this purpose there will be installed six Allis-Chalmers transformers of 2,500-kilowatts capacity. The turbines will have an overload capacity of twenty-five per cent. The turbines will be equipped with surface condensers of the Wheeler Condenser & Engineering Company's manufacture. The turbine room will be spanned with a four-motor Cleveland Crane & Engineering Company crane with a sixty-ton main hoist and a fifteen-ton auxiliary hoist.

From the Riverside Station there will be run an underground system of 13-200-volt transmission lines to a new substation to be located at the site of the old Main Street generating station, the distance between the two being about two and one-half miles. There will also be an underground transmission line connecting with this line and running to the present Fifth Street Edison substation and also to a new substation to be located on Sixth Street.

The new Main Street substation will receive part of its current from the Riverside generating station and part from the Taylor's Falls waterpower plant. This high-tension current will be stepped down to 2,300 volts for local distribution. From this substation there will also radiate the 500-volt direct-current lines for city arc lighting.

The Sixth Street substation will receive current at 13,200 volts which will be converted into 250-volt direct-current.

The entire design and construction of the generating station and new substation is in charge of the Stone & Webster Engineering Corporation, Boston, Mass.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

THE RATIO OF LIGHT TO ILLUMINATION.[1]

BY HAYDN T. HARRISON.

Only within the last few years has artificial illumination been dealt with as a separate science; therefore it is not surprising that some of the terms connected with it are often used with different meanings, thus leading to confusion.

The very title of this paper would confuse many who are in the habit of looking upon light and illumination as the same thing; but I prefer to treat the definition of light as that which causes illumination, whether that illumination is visible or not.

I agree, for instance, with Mr. Trotter's definition of illumination as depending simply on the quantity of light falling upon a surface, and that it has nothing to do with the color or reflecting value of that surface. Therefore, it would be, strictly speaking, inaccurate to state that an instrument indicated the illumination except when it was pointed at a white screen of similar material to the screen in the instrument itself and which is illuminated to a predetermined degree.

In order to demonstrate my point I carried out the following experiments with my Universal photometer as made by Elliott Brothers. As you are aware, this instrument consists of a screen capable of angular displacement, thus varying the degree to which it is illuminated by a standard lamp. This screen is used in conjunction with the Whitman sector flicker disk, and thus indicates the degree of illumination derived from a source of which the candlepower value can be calculated. The advantage of using this instrument was that, by replacing the standard comparison screen by the various tinted wall papers which Mr. Waldram used in his experiments, I could ascertain very accurately the increased illumination necessary in order that the rays reflected from such wall papers should have the same effect on the eye as when a white paper of similar surface to the photometer screen was used.

As the results of my experiment may be interesting I give them below:

Screen No.	Color	Increased Illumination Necessary.
1.	Bright red	3.5 times
2.	Dull cardinal red	6.5 "
3.	Medium blue	4.8 "
4.	Light blue	3.2 "
5.	Dark green	7.0 "
6.	Light green	2.2 "

Another interesting point that these tests proved was that the angle of incidence of the light rays closely followed the cosine law over the greater part of the angular movement, despite the fact that the surface of these wall papers was far from a plane one.

My next experiment was to ascertain the value of the light reflected from the area of these papers compared with that of white blotting paper, and I found that though these tests were made under very different conditions and very roughly, owing to the short time available, they to all intents and purposes corroborated the figures given above, thus proving that an instrument of the Holophane Lumeter class measures correctly the irregular reflecting value of a surface.

Mr. Dow and Mr. Mackinney, when describing their Holophane Lumeter instrument in the *Illuminating Engineer* (May, 1910), stated that it could be used to measure either intrinsic brilliancy expressed in terms of candles per square centimeter, or illumination expressed as lux or foot-candles "which a truly white surface would have to receive in order to have an equivalent brightness."

This description is quite correct, except that it might be taken to mean that the instrument indicates either intrinsic brilliancy or foot-candles, thus making it appear that they were one and the same thing. This, of course, is not so, therefore, it must be clearly understood that it only measures foot-candles when a special screen is used.

It is interesting to note here a remark of Mr. Trotter's, viz.: "Such terms as illumination, brilliancy, brightness, intensity, and luminosity are generally employed by different writers to express different ideas, and are often used in a confused, vague way." This, unfortunately, is as true today as when it was written, therefore, it is not surprising that it is difficult to fix definitely a unit which accurately describes reflecting value, and I doubt whether a better word than "luminosity" could be chosen. Sir William Abney describes luminosity as brightness resulting from illumination, which is exactly what the Holophane Lumeter measures. But in this case are we to regard "luminosity" as denoting luminous flux per unit area, so that it would be expressed, say, in lumens per square inch? Or as denoting candlepower per unit of area?

With regard to the other terms, personally I use them in the following sense:

1. Light.—The emanations from a light source.

2. Illumination.—The extent to which anything is illuminated; foot-candles.

3. Brilliancy.—Refers to primary light source and is candlepower divided by area.

4. Intrinsic Brilliancy.—Candlepower per unit surface (square centimeter).

5. Brightness and Intrinsic Brightness.—Same as brilliancy.

6. Luminosity or Luminous Intensity.—Same as brilliancy, but applied to secondary sources of light.

I only put the above table forward as suggestive, and would like to see the terms "brilliancy" and "brightness" always applied to primary light sources, as considerable confusion, which is now caused by their indiscriminate use, would be obviated.

For example, many people talk about

1 A paper (slightly condensed) presented before the Illuminating Engineering Society, of London, England, April 24.

a bright light, and this under the above classification would be correct; but for an artist to talk about a bright color would be incorrect. But, on the other hand, an artist and a colorman think on different planes; a color is bright to an artist under one condition and dull under another, whereas to a draper or a colorman a color is *ipso facto* a color describing something when viewed under normal light, and he would not grant that the color is changed when viewed under an abnormal light, but that the light is changed. Therefore, the luminosity is changed, whereas illumination is not changed by the fact that it falls and is reflected to the eye in a varying degree dependent on its color.

If luminosity or luminous intensity is used as applied to indirect or secondary sources of light, the value of these sources could be stated in lumens instead of candlepower, which would simplify matters considerably. For example, if we could state that any given area in a room was illuminated to a certain degree in foot-candles by direct light from a source plus so many lumens in the form of indirect illumination, we should know at once the relative reflecting value of the surroundings of the light source, and also the likely density of the shadows. This would not be a difficult thing to measure, as, by shading the direct light from the measuring surface, we get the illumination due to the lumens (indirect lighting) only.

Dr. Louis Bell points out that altering the position of the primary source of light in a room does not affect the illumination seriously if the walls and ceiling diffuse strongly (*i. e.*, have a high degree of luminosity), while, if they are dark, the change is decidedly unfavorable. I will go further than this and say that if the walls and ceiling have a 100-per-cent luminous efficiency and the light, though invisible, is placed so as to illuminate them, the resulting illumination will have a maximum efficiency. On the other hand, if the walls and ceiling have no luminous efficiency and no direct illumination is derived from the source of light, the illumination will be zero. The various stages between these two limits will be inversely proportionate to a table similar to that given in the early part of this paper. If this theory is correct, the illumination at any part of the room will be proportionate to the direct illumination plus the illumination due to light reflected from the surfaces visible from the point of measurement.

The measurement of the illumination derived from all sources is, of course, an easy matter, such instruments as the Trotter photometer, Holophane Lumeter with subsidiary screen, and several others, being available for the purpose; but to ascertain the light value of the original source of such illumination is a very different thing.

The importance of ascertaining this light value arises when a question of cost and efficiency is under consideration, and the only satisfactory method is either to eliminate all reflecting sources or to remove the lamps to the test-room. In either case the question presents itself as to what is the light source—is it the lamp only, or the lamp plus the globes and reflectors, which may considerably enhance its value as an illuminating agent?

It must be borne in mind that globes and reflectors only enhance the lamp's value as a light source for the purpose of giving direct illumination, and often depreciate its value from the point of view of the reflected illumination derived from the surrounding objects. Therefore, the value of the naked lamp alone must be known, and this is, of course, easy to ascertain by the usual photometric methods. The value of such a lamp plus globes or reflectors is a more complicated matter, owing to the area of the light source being increased and thus interfering with the square law of photometry. Under these circumstances, unless means are available for obtaining the profile curve of lighting, the only way to ascertain the illuminating value of a light source, including reflector, etc., is by ascertaining the illuminating results.

For this reason I would suggest that all makers of lamps who wish the apparatus supplied by them to be used to the best advantage should accurately state the candlepower derived at various angles, and should not be content with stating either the maximum, horizontal, or mean spherical or hemispherical candlepower. If makers would do this, the lamps or combinations of lamps with globes and reflectors would be divided into classes, which would not only greatly assist illuminating engineers, but would result in the goods supplied being used to the satisfaction of the public.

This naturally leads to the consideration of the relative merits of lights with reflectors or globes which increase the illumination in the direction required, versus unprotected lights from which good illumination is obtained by the using walls or ceiling as reflectors.

It is obvious that as regards efficiency the use of reflectors will generally have the advantage. Take, for example, a room with white ceiling and walls. The upper hemispherical rays are reflected back into the room and usefully increase the illumination, but, on the other hand, a reflector placed directly over the lamp, provided it receives all the upper hemispherical rays, will even more efficiently direct them to the remainder of the room where illumination is required, but will leave the upper part of the room in comparative darkness. In the case of a room which has not a white ceiling and wall paper the efficiency of a reflector will be comparatively higher, and, what is even more important, will remain constant owing to the fact that it can be cleaned more often than it is convenient to whitewash the ceiling and walls of a room. But the physiological (light sensation) effect is different, because the illumination is derived from a single source, while in the other case it emanates from all directions.

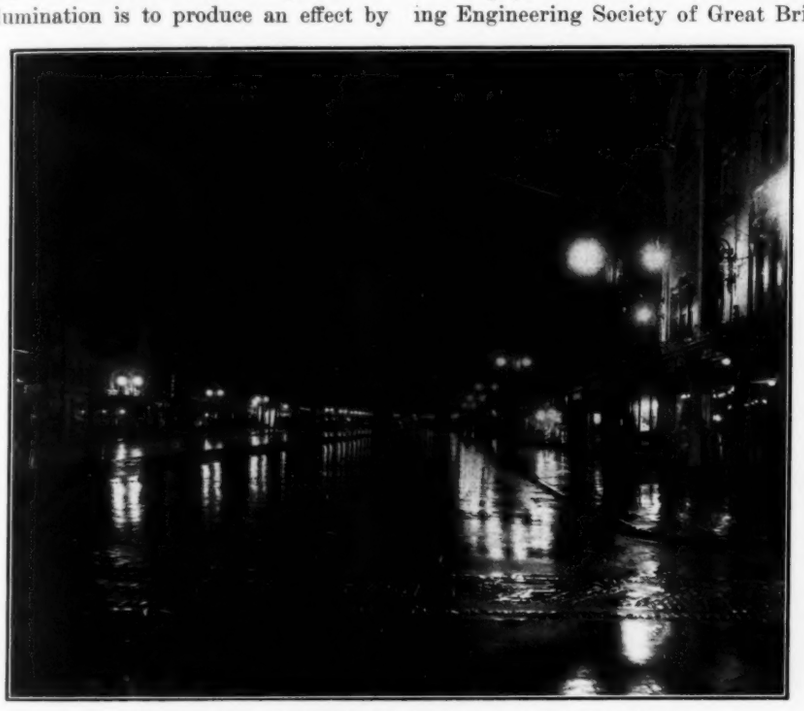
I am prepared to grant that a person entering a room with light colored ceiling and walls will often state that it is better illuminated than a similar room where the surroundings are dark colored. Nevertheless, the illumination in the latter case may be better than in the former, and possibly the physiological effect would eventually prove more generally satisfactory as the high luminosity of the surroundings would tend to close the iris, thus producing a trying effect on the optic nerve if an attempt to work is made under those conditions.

This is where the province of an illuminating engineer becomes very simlar to that of a physician. The latter cannot always tell the effect of the drugs he prescribes on various people, and often has to use the trial and error method; so the illuminating engineer will have to learn the effects which are most likely to please his clients.

For example, very few men would like to work in a study or dine in a dining-room where the light emanates from all directions and where the iris of the eye is kept constantly contracted by the high luminosity of the surroundings. On the other hand, many of the opposite sex would prefer it, owing, I fancy, to

their desire to exhibit themselves and their costumes. Nature, however, tones down the luminosity of surroundings as the brilliancy of the sunlight increases, by providing them with a covering of green which is restful to the eye.

Artists have learned that in order to depict high illumination they must have strong contrasts, such as the deep shadows provided by nature, and I think in this respect they teach illuminating engineers a lesson. Shadowless illumination is always depressing, just as a day when the sun is obscured by clouds is depressing; and I think it would be wise to deliberate carefully before any system of shadowless illumination is adopted, and to remember that the object of all illumination is to produce an effect by which the outlines of objects are easily seen, which result is greatly assisted by the effect of light and shade.



MAGNETITE-ARC LIGHTING IN PENN SQUARE, READING, PA.

Ornamental Lighting at Reading, Pa.

The merchants of Reading, Pennsylvania, determined some time ago to have a "white way" and have argued sanely and successfully that the installation would be a credit to the City of Reading, and should be maintained by it. The portion of the city selected was Penn Square, which is approximately 1,000 feet long and 120 feet wide. Twin 320-watt magnetite lamps equipped with diffusing globes were selected. The equipment consists of handsome cast-iron posts supplied from underground mains. The lamps hang seventeen feet above the sidewalk and the posts are ninety-six feet apart. The installation was furnished complete by the Metropolitan Electric Company. The lamps burn all night and every night, and are paid for by the city on its regular street-lighting contract. The system has proven so successful that arrangements have been made to extend the system throughout the whole length of Penn Street, the main business street of the city, for a distance of nine blocks, nearly a mile in length.

The Effect of Wall Papers on Illumination.

In a paper read before the Illuminating Engineering Society of Great Britain on April 24, P. J. Waldram gave particulars of tests made to ascertain the effects of wall papers in a given interior which he was completing. The following abstract of this paper is from the *Mechanical Engineer*. The method adopted was to divide the floor, walls, and ceilings into a number of equal rectangles. The candlepower distribution curves of the lamps having been measured, readings were taken with an illumination photometer of the illumination received by a detached test plate placed in the center of each rectangle. Then another series of readings was taken with a small black screen placed about half-way between the test plate and each lamp, so as just to cut out the direct lamp rays whilst obliterating as little as possible of the light reflected from the ceiling. This second set of readings isolated the increase due to all reflections and counter-reflections for that size of room and color of wall and ceiling surfaces, and the difference between the sets of readings should equal the direct flux as calculated from the candlepower curves.

A room about 19 feet by 12 feet 3 inches by 10 feet papered with very dull red paper, possessing a coefficient of reflection of only about 11.5 per cent was temporarily fitted with two thirty-five watt Mazda pendant lamps and tested with different Holophane shades varying the incidence of the light rays. The walls were then altered from a comparatively bad to an approximately best condition by covering them temporarily with white lining paper with a coefficient of reflection of 100 per cent, and similar readings were taken. Under average conditions the increase of flux of illumination on walls by reflection tended to vary between fifty and seventy per cent with white wall paper, down to between twenty and thirty per cent with very dark papers. The increase of flux of illumination on white ceilings appeared to be in about the same proportion as on the wall papers to which they were adjacent.

The Significance of the Introduction of Drawn Wire for High-Efficiency Lamp Filaments.

Now that a majority of the incandescent-lamp companies of this country are using drawn-wire filaments for practically their entire output of high-efficiency lamps, it is well that the real significance of this important step in lamp manufacture should be considered. The new construction has been generally adopted for all regular sizes and types, except for the lower wattages in the high voltages (200 to 250 volts, 45 and 60 watts). This means that miniature, train-lighting, low-volt, street-series, compensator and automobile lamps, as well as the regular 100 to 125-volt types, may now be obtained with drawn-wire filaments.

The new construction does not give us a non-breakable lamp, although it greatly reduces fragility. Metal lamps should still be handled with care both in shipment and in service, as the filament after burning loses some of its mechanical strength. The conclusion

should not, however, be drawn that no further improvements are to be expected in the incandescent lamp. The research laboratories are as busy as ever, and there is good reason to suppose that the drawn-wire lamp is the forerunner of even better lamps in the future, although what the next important development will be, and when it will occur, can only be conjectured.

Neither should it be assumed that the new construction has made metal-lamp manufacture an easy, inexpensive diversion, since the process of drawing

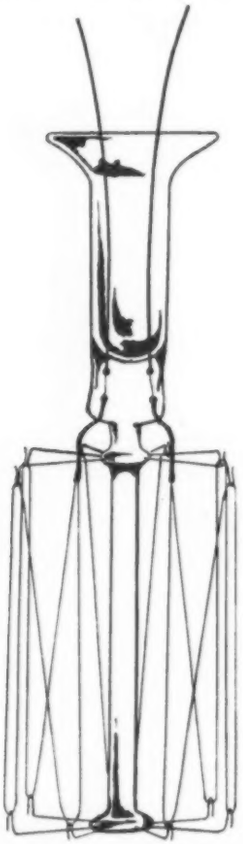


FIG. 1.—MOUNT WITH DRAWN-WIRE FILAMENT, BEFORE SEALING IN.

the densest kind of wire down to almost microscopic dimensions, especially when that wire must pass the most exacting tests for quality and uniformity, involves a long, costly series of operations, and is beset with many disturbing factors, all of which must be watched with great care.

What the new method of lamp construction does mean may be epitomized as follows.

To the public, it means that the same general methods of filament mounting that have been found so successful in the tantalum lamp have now been made practical for its more efficient rival, and this has been accomplished without entailing the mediocrity of performance on alternating current which was characteristic of the tantalum filament.

To the lamp manufacturers, the new development signalizes a triumph of invention and research. The metal which less than a dozen years ago was known in its pure form only as a dense, infusible, black powder, is today drawn into wires of half the diameter of a human hair. The manufacturer now has a high-efficiency filament material possessing all desired flexibility and strength when put into the lamp, although, as above intimated, the completed lamps will not withstand football tactics, as burning tends to make them less rugged. The accompanying picture shows a freak lamp with a large number of loops and knots in the filament, showing how easily it can be bent before mounting. Like many other inventions, the drawn-wire filament has meant and will mean the abandonment of much costly and highly specialized machinery. More than that, it has meant that employes who had become specially skilled in the performance of operations connected with the manufacture and inspection of pressed filaments, must now be trained to do entirely different operations, since their skill in the old kind of work has lost its market value. The ruthless scrapping of many tens of thousands of dollars' worth of machinery and materials is indeed a notable example of the way in which the modern manufacturer tears down his barns to build greater.

To the electrical jobbers, dealers and contractors all over the country, the new lamp will mean less breakage in shipment and in stock. It will be an easier lamp to sell and it will bring a large amount of electrical construction work in residences and other buildings where its introduction will mean the introduction of electric light itself. More fixtures, more reflectors and more of the hundred-and-one accessories and current-consuming devices will be used.

From the central station's standpoint, the new lamp is sure to have the effect of increasing the number of high-efficiency lamps on the circuits, and thus of increasing the average efficiency of all the lamps in service. Thus it brings the high-efficiency lamp problem once more forcibly before the attention of the central-station manager and shows him the necessity for such a public policy as regards rates, publicity, etc., as will enable the central station to share with the consumer the advantages of the saving made possible by the high-efficiency lamps. It will be an effective instrument in the hands of new-business men. To many central stations it will mean that whereas they have not hitherto found it advisable to carry metal lamps in stock or to supply them to their customers, the policy in this respect will be reversed.

To one and all the drawn-wire lamp means another reduction in the cost of light; another extension of the field

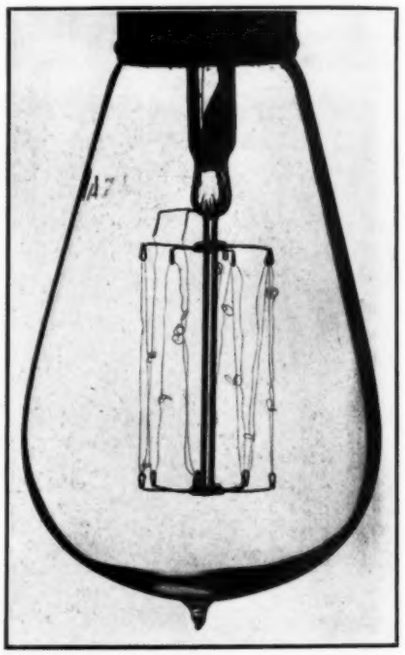


FIG. 2.—FREAK LAMP, WITH LOOPS IN FILAMENT.

in which high-efficiency incandescent lamps are advantageous.

Working Metallic Tungsten.

Tungsten, like chromium, is not malleable, and it possesses hardness and brittleness but not ductility in ordinary or heated conditions. According to *Mining Science*, it has been discovered that if the metal is worked while hot, as by hammering, rolling, drawing, or the like, it progressively changes, and after a certain amount of working takes up such molecular structure or characteristics as permit mechanical working at room temperatures. In fact, under such treatment it becomes so ductile as to allow of bending, rolling, and drawing, either at ordinary temperatures or hot, as may be preferred.

TELEPHONY—TELEGRAPHY, and WIRELESS.

SOME RECENT ADVANCES IN TRANSMISSION EFFICIENCY OF LONG-DISTANCE CIRCUITS.

BY B. GHERARDI.[1]

THE NEW YORK-DENVER CIRCUIT.

The New York-Denver circuit has a length of a little over 2,000 miles, that is, it is more than twice as long as the New York-Chicago circuits, which are about 950 miles long, and is a little less than twice as long as the New York-St. Louis circuits, which are about 1,050 miles long. Until the completion of the developments which have made the New York-Denver circuit possible, the New York-Chicago and the New York-St. Louis circuits represented practically the limits of long-distance transmission. Now service from New York to Denver can be given which is as good as, or even better than, the service given a year or two ago from New York to St. Louis or Chicago, and this without using any heavier wire than was formerly employed. All our old circuits from New York to Chicago and St. Louis were No. 8 B. W. G. wire, weighing 435 pounds to the mile. No heavier wire is used to get the New York-Denver service.

One of the aims of our president, Mr. Vail, is to give universal service. The first step in the direction of giving such service is obviously to be able to give transcontinental service—that is, a talk from New York to San Francisco. The diagram, Fig. 1, will show how much of a step in this direction has been made since Mr. Vail's wish on this matter was stated about two years ago. This diagram shows what we could do two years ago, what we can do now, and how much remains to be done to get to San Francisco. It was a long step from Chicago to Denver. One more step a little longer will take us to San Francisco.

FIG. 1.—LONG-DISTANCE CIRCUITS, AMERICAN TELEPHONE & TELEGRAPH COMPANY.

Fig. 2 shows in a general way the New York-Denver circuit. From New York to Morrell Park (the test station just outside of Chicago) there are two loaded No. 8 circuits. These are phantomed, thus creating a third circuit, and this phantom is also loaded. From Morrell Park to Omaha there is a loaded No. 8 circuit. No loaded phantom has as yet been provided here, because the pole line did not carry two No. 8 circuits so located with relation to each other that they could be phantomed. Arrangements are being made to move a No. 8 circuit on this line to pins adjacent to the present loaded No. 8 circuit, and as soon as this is done a phantom will be created from the two circuits, and this phantom will also be loaded, thus giving between Chicago and Omaha the same arrangement as now already exists between New York and Chicago. From Omaha to Denver there are two No. 8 circuits which have been phantomed, thus creating a third circuit, and the two physical circuits and the phantomed circuit are all loaded, thus giving from Omaha to Denver the same general circuit equipment as now exists between New York and Morrell Park.

The circuit from New York to Denver, utilizing the phantoms where they exist and including the reflection losses due to the present irregular arrangement, is equivalent in transmission efficiency to about thirty miles of standard cable. The circuit, if connected throughout on a non-phantomed physical circuit over the same route, is equivalent to about thirty-two miles of standard cable. When the final arrangement is completed between Chicago and Omaha our present estimate is that a New York-Denver connection on the phantom will be equivalent to between twenty-eight and twenty-nine miles of standard cable. If the circuit were made up throughout of unloaded No. 8's it would be equivalent to sixty-nine miles of standard cable. A No. 8

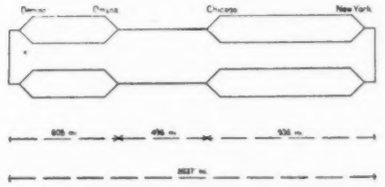


FIG. 2.—GENERAL ARRANGEMENT OF NEW YORK-DENVER CIRCUIT.

1 Engineer of Plant, American Telephone & Telegraph Company.

unloaded circuit from New York to Chicago by the shortest route is equivalent to about thirty-four miles of standard cable from test board to test board. It will thus be seen that the new circuits to Denver are better than our old circuits were to Chicago. Not only are they better, but they are cheaper, because with the art as it was two years ago with four No. 8 wires we could get two circuits; now with four No. 8 wires and some coils and insulators we get three circuits of more than double the transmission efficiency. It is interesting to consider what results these cheaper circuits will accomplish when used in conenction with the Chicago business. The No. 8 unloaded circuit to Chicago has a transmission efficiency of thirty-four miles. By the use of telephone relays or repeaters this can be cut down to about twenty-two or twenty-four miles. The efficieney of the No. 8 loaded circuits from New York to Chicago is equivalent to about seventeen miles of standard cable. The efficieney of the loaded phantom is equivalent to about fifteen miles of standard cable. As soon as certain additional circuits via Pittsburg are loaded and phantomed, we shall start using the high-grade circuits for New York-Chicago business.

LOADING NO. 8 CIRCUITS.

The problem of loading No. 8 circuits was primarily a problem in connection with the insulation of the line wires. A No. 8 circuit can be loaded with the same coils used on No. 12 circuits, and these coils would be spaced in the same manner, that is, at eight-mile intervals. It has been a fact known to us ever since we started to do commercial loading that low insulation on a loaded circuit has a much greater effect in impairing the efficiency of such a circuit than the same insulation has on an unloaded circuit. It has also been known that the effect of low insulation on the No. 8 circuits was much more serious than on the No. 12 circuits.

It having been established that a substantial improvement would have to be made in the insulation of No. 8 circuits in order that they might be successfully loaded, and reasonable uniform results obtained from the loading, a study of line-insulation conditions was made to determine what steps would be necessary in order to improve the line insulation. Aside from the general insulator leakage two particularly weak points were found in the insulation of open-wire circuits. One of these was at transposition points. Fig. 3 shows the arrangement of the wires on a standard single-pin transposition. It will be seen that with this arrangement there is a very direct leakage path from one wire to the other during wet weather. The part of the insulator surface protected by the petticoat is the only part that is of much value during wet weather. Actual measurements showed that the leakage on lines equipped with standard single-pin type transposition insulators was twenty per cent greater during wet weather than on lines where the two wires were never allowed to be on the same pin. Of course the old standard transposition which employed two insulators, both of the transposition type, and in which the wires were tied to both of them, was just twice as bad as the single-pin transposition already discussed. The method of overcoming this difficulty was to transpose the wires without bringing them onto the same insulator. This is accomplished in the manner shown in the second part of Fig. 3, that is, to employ the phantom transposition bracket for transposing a physical circuit. The same problem, of course, arises when phantoms are involved and having used the phantom bracket for the transportation of physical circuits, something else is required when phantoms are involved. This arrangement is also shown in the diagram. By the means described above the transposition as a factor in producing low insulation is eliminated and the transposition points are made just as good as any other point in the line.

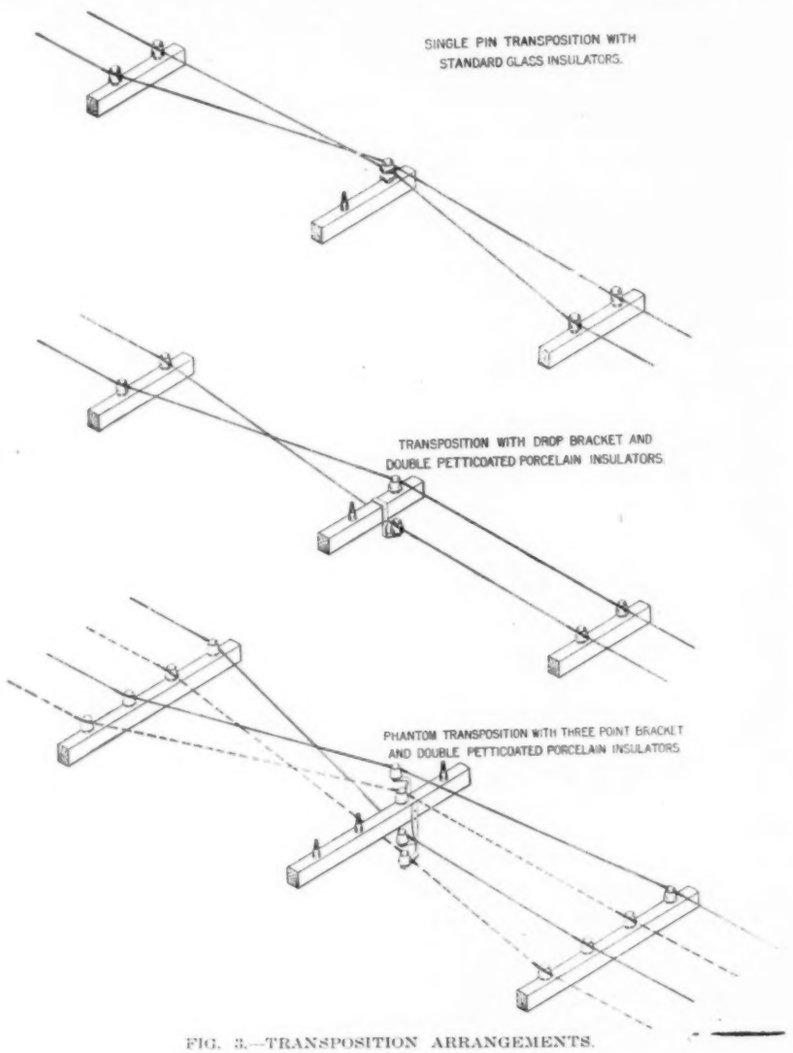

SINGLE PIN TRANSPOSITION WITH STANDARD GLASS INSULATORS.
TRANSPOSITION WITH DROP BRACKET AND DOUBLE PETTICOATED PORCELAIN INSULATORS.
PHANTOM TRANSPOSITION WITH THREE POINT BRACKET AND DOUBLE PETTICOATED PORCELAIN INSULATORS.

FIG. 3.—TRANSPOSITION ARRANGEMENTS.

Another point at which it was found that there was considerable leakage was where, for the purpose of inserting loading coils, connecting with a test station, or for any other reason, the wires were bridled. These places were

particularly bad during wet weather, especially after the bridle wire had been in service for a short time and had weathered. The path of this leakage is shown in Part 1 of Fig. 4. The braid on the bridle wire soon becomes weathered and when wet is a fair conductor. Leakage takes place easily over the wet surface at the end of the rubber insulation and thence to the wet braid. This difficulty was overcome by a very neat device known as a bridle-wire insulator. Part 2 of the diagram shows a picture of such a bridle-wire insulator, and Part 3 shows a cross-section of it. The two wires shown in connection with this bridle-wire insulator extend—one to the loading coil and the other to the lightning arrester. The adoption of this arrangement has completely eliminated low insulation at bridling points.

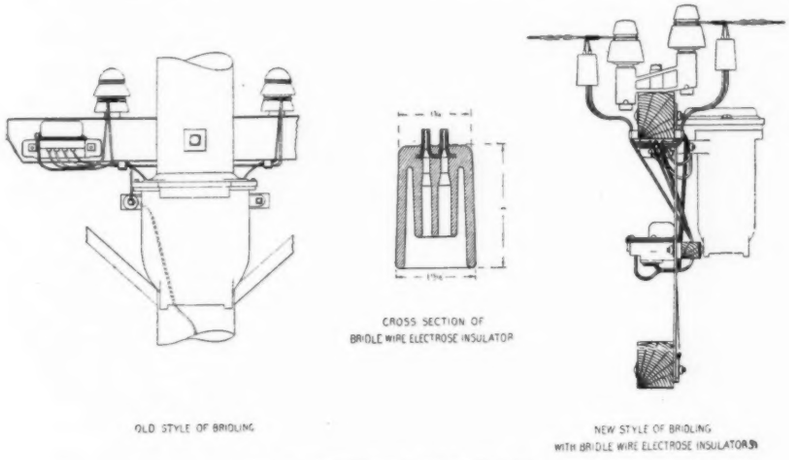

CROSS SECTION OF
BRIDLE WIRE ELECTROSE INSULATOR
OLD STYLE OF BRIDLING
NEW STYLE OF BRIDLING
WITH BRIDLE WIRE ELECTROSE INSULATORS

FIG. 4.—METHODS OF BRIDLING.

In addition to the changes at transposition points and at bridling points referred to above, it was thought desirable on the first of these loaded No. 8 circuits to use a line insulator that would be more efficient than our standard glass insulator. After a careful study of insulator design and insulator materials, it was decided to try on these circuits a double-petticoated porcelain insulator. Tests on these insulators extending over a period of several years have shown that the new insulator is several times as good in wet weather as the standard insulator.

PHANTOMING NO. 8 CIRCUITS.

The problem of the phantoming of No. 8 circuits is one in phantom repeating coil design. To meet the special conditions existing in connection with the phantoming of loaded No. 8 circuits as used in our plant, it was desirable that apparatus should be developed of the highest possible transmission efficiency. In order to do this the ringing efficiency of the phantom coil was sacrificed and special means for ringing through these coils had to be adopted. In this way and by specially designing a coil to meet the circumstances of these circuits, coils that were suitable were developed. The manner in which these coils are used in phantoming a circuit is shown in Fig. 5.

THE LOADING OF PHANTOM CIRCUITS AND THE PHANTOMING OF LOADED CIRCUITS.

Up to very recently, while we know how to phantom ordinary circuits, it was impracticable to phantom loaded circuits because the loading coils so unbalanced the phantom and so increased its effective resistance that a phantom circuit created out of loaded circuits could neither be made quiet nor made efficient from a transimssion standpoint. This problem is one of loading coil design. The reasons why ordinary loading coils were unsatisfactory when used on circuits which were to form parts of a phantom will first be stated.

Fig. 6 shows the arrangement of the windings in an ordinary loading coil. The arrows show the direction in which the current flows in the windings at a given instant and the direction of the corresponding magnetizing forces in the loading-coil core. If the windings are distributed uniformly over the core, such an arrangement as this produces no external magnetic field. The second part of this diagram shows the same loading coil and the conditions which would exist in it with reference to the telephone current flowing in the phantom circuit. This current, of course, passes in parallel along the two sides of the physical circuit. It will, therefore, magnetize the two halves of the loading-coil core in opposite directions. This will produce magnetic poles at the two sides of the core and a great amount of magnetic leakage at these points. The results of this magnetic leakage, which would be different in different cases, would be to make it impossible to get the two side circuits sufficiently alike so as to balance the phantom; would introduce substantial crosstalk due to the stray magnetic field affecting other loading coils, and would bring in serious losses because this stray magnetic field would pass through the solid iron of the loading-coil case, bringing in hysteresis and eddy-current losses.

In order to overcome this difficulty it was necessary, to devise special arrangements of the windings on the loading coil, so that while the coil would still be effective in respect to the current flowing in the physical circuit, the effect of the current flowing in the phantom circuit would be such as not to magnetize the loading-coil core. These windings had not only to be balanced magnetically, but also to be so arranged that the electrostatic capacities between the various windings of the coil would not unbalance it. Such coils were devised and are now in successful use on the New York-Denver circuit.

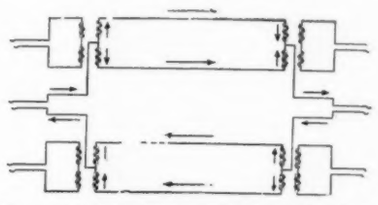


FIG. 5.—MANNER OF EMPLOYING PHANTOM COILS.

The phantom produced in this manner is, however, not loaded. It is, of course, desirable to load the phantom in order to obtain the benefits of improved transmission on this circuit also. To do this another coil was devised, the windings of which were so arranged that they would introduce inductance in the phantom circuit without affecting the side circuits.

An important piece of work which it was necessary to carry on in parallel with the work dealing with the wire plant, was the development of a satisfactory cord circuit to be used with

these very efficient loaded lines. Very successful results have been obtained in this direction, and a cord circuit has been devised on which the transmission losses are almost negligible. With the new cord circuits the loss brought in on the New York-Denver circuit by the two terminal cords at the toll switchboards at New York and Denver and the two intermediate cords at Morrell Park and Omaha is only 0.3 miles of cable. With the old type of cord circuit these losses were substantially greater. The losses with the old cord circuits were equivalent to making the line from New York to Denver 300 miles longer than with the present arrangement.

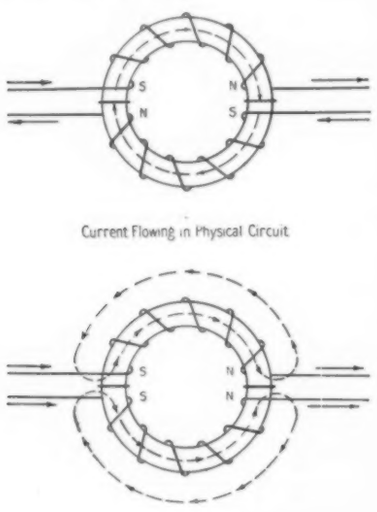


FIG. 6.—ARRANGEMENT OF WINDINGS IN LOADING COIL.

THE BOSTON-WASHINGTON CABLE.

The project of having a complete underground conduit connection from Boston to Washington, and having therein a cable which would insure the service between these points against failure from storm damage, is another of Mr. Vail's great ideas which is about to become a reality.

The underground conduit between New York and Washington is now completed, except for a few miles, and these will be built before the summer. The underground conduit between New York and Boston is to be completed this season. This will make a continuous underground cable route about 475 miles long.

It is proposed to place therein an underground cable, some of the circuits of which will be so efficient from a transmission standpoint that it will be possible to give telephone service between Washington and Boston over these underground conductors. This will be by all odds the longest telephone cable in the world.

The make-up of this cable is shown by Fig. 7. In the middle of the cable there are fourteen pairs of No. 10 B. & S. gage conductors. Outside of these there are thirty pairs of No. 13 gauge conductors. In the spaces between the No. 13 gauge conductors and the No. 10 gauge conductors, six pairs of No. 13 gauge conductors have been put in because there was space for them. At the outside of the cable eighteen pairs of No. 16 gauge conductors have been placed because there was room for them. All of the No. 10 gauge pairs and the No. 13 gauge pairs, except the six put in between the 10's, are arranged so that they can be phantomed. That is to say, they are arranged in what we call a "quad formation." Each of these quads is built up by taking the two twisted pairs and twisting them together, giving due attention to the length of twist employed on the pairs, and in twisting the pairs together.

I have already mentioned that the loading coils themselves are of the same general type as those used for loading aerial phantoms and the side circuits of phantoms. Those for use on the No. 10 circuits are almost as big as the coils used for loading open wire circuits. It is necessary to make them of this size in order to reduce the losses in the coils to a sufficiently small amount. The coils are spaced at intervals of about 1.4 miles, the side circuit coils and phantom coils being placed at the same point. This spacing is determined by the capacity of the conductors, the side circuits having a mutual capacity of about 0.070 microfarad per mile and the phantom having a mutual capacity of about 0.1 microfarad per mile.

The transmission efficiency of these circuits is interesting, and in this connection I may say that while a sufficient amount of this cable has not as yet been manufactured to permit of actual transmission tests on it, so great is our confidence in formulæ for computing these efficiences which have been developed as a result of our studies and experiments that we are satisfied that the results predicted will be obtained, and the manufacture of about 150 miles of this cable at a cost, including loading, of about $1,000,000, has been recommended.

The distance from New York to Washington is 235 miles. The most efficient circuits in this cable will be the No. 10 phantoms. These will have a transmission efficiency equivalent to only thirteen miles of standard cable. That is, they are nearly twenty times as good as standard cable and decidedly better than unloaded aerial No. 12's. The physical No. 10 circuits will have a transmission efficiency between New York and Washington of sixteen miles of standard cable. The phantomed 13's—twenty-one and one-half miles of standard cable, and the physical 13's—twenty-eight and one-half miles of standard cable. These last circuits would not give good service from all subscribers in Manhattan to all subscribers in Washington. They will, however, be very useful from New York to Philadelphia, Wilmington and even Baltimore, and for other combinations such as Philadelphia and Washington. Between Boston and Washington the only circuits that can be counted on for commercial service will be the phantomed No. 10's. These will give a transmission efficiency between test boards of twenty-six miles. This will be sufficient to insure the service in case the open wire lines are down, although it is not expected that they will have to be used in this way, because it is not likely that there will be so many breaks in the lines that the cable would have to be used at any time all the way from Boston to Washington. All open wire lines are not likely to be down at the same time both north and south of New York. The cable intersects the aerial lines at many points so that patches can be made at short intervals.

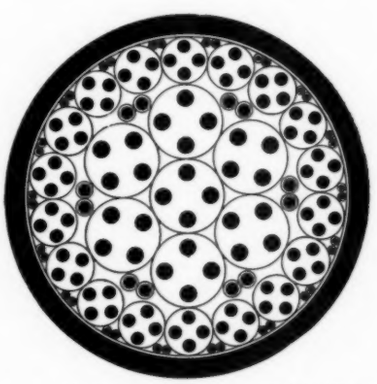
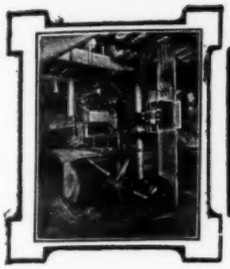
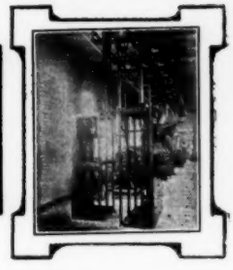


FIG. 7.—MAKE-UP OF BOSTON-WASHINGTON CABLE.



Industrial Power



ELECTRICAL POWER AS AN AID TO MINING.

C. H. PALMER.

Electrical power for mining may either be produced at the mine head, or obtained from a conveniently situated public service company; if obtained from the latter source the three-phase alternating current is usually supplied, which enables any pressure whatever to be adopted for distribution purposes. Such supply can also, though with less readiness and lower efficiency, be converted for distribution as direct current. An important point is, whether direct current is the more desirable or the three-phase alternating current, for underground distribution? Many experts assert that three-phase alternating current possesses overwhelming advantages of an essentially practical nature, such as safety, economy and convenience, which may be summarized as follows: (1) The first cost of a three-phase motor is about thirty per cent lower than that of a direct-current motor of corresponding size. (2) Three-phase motors are of better mechanical construction than direct-current motors; breakdowns are, therefore, less likely; (3) If motors of the squirrel-cage type are used, no complicated starting and regulating apparatus is required; (4) Three-phase motors have greater overload capacity than direct-current motors, and for variable loads a smaller motor with three-phase distribution is an obvious economy; (5) As there is no commutator, fire risk is reduced to a minimum; commutators require frequent attention to secure sparkless running; with three-phase squirrel-cage motors, there is a complete absence of rubbing contacts carrying current, there can therefore be no sparking during ordinary working. By means of a transformer, any pressure desired may be used for small motors, or local lighting, and electricity can be economically transmitted any distance and used direct, or transformed for use as may be found convenient There is great freedom from risk of lighting explosive gas, as the circuits may be made and broken under oil. On the other hand, there is the disadvantage that the voltage remaining the same, the cables of a direct-current system cost thirty per cent less than those of a three-phase system. Direct current for mine work must necessarily be distributed at the pressure at which it is generated and the difficulty of securing sparkless commutation at high pressures limits the pressure of generation to but little above that defined as "medium pressure," namely, 650 volts. It follows that before any very considerable distance is reached, the absence of a voltage limit places the three-phase system in a favorable position, even as regards the capital cost of distribution.

Another important point which arises is the special danger of possible explosions, and whether the three-phase distribution, or direct-current is the safer.

Expert opinion appears to be practically unanimous in stating that the former, with our present appliances, is the more reliable. The practical requirements for safety in operating electrical plant underground include:—strong metallic coverings as protection from all mechanical damage and as a protection wherever accidental contact with current-carrying parts would otherwise be possible; these metallic coverings require a good earth connection. As soon as leakage begins to appear, current must be immediately automatically cut off and wherever there is a possibility of either gas or dust explosion, circuits must be made or broken, either under oil, or in properly designed explosion-proof chambers. The metallic covering and good earth connection mentioned above, apply to both the three-phase and direct-current systems; but the automatic cut-off and the under-oil circuits can only be conveniently met by the former.

It is essential to connect to earth the neutral point of the generator, or transformer winding, in order to provide for cutting off the current automatically immediately upon the slightest indication of leakage. This neutral point may be defined for practical purposes, as the mid-voltage point, and the effect of connecting it to earth in conjunction with the use of an armored-cable system is to provide a direct path of low resistance for leakage current from a faulty cable or piece of apparatus, via the armoring back to the generator or transformer. The adaption of this system enables an important result to be attained; if all leakage currents be confined to the earthed metallic covering of the cables and apparatus. The use of quick-acting automatic protective devices is facilitated and their use clearly reduces the danger arising from sparking and arcing to a minimum. The broad result attained is that by the use of quick-acting protective devices, current may be automatically cut off from any faulty cable, or apparatus immediately a fault begins to develop, before the leakage to earth reaches any appreciable amount, and long before an ordinary fuse, or automatic overload device would come into operation; an important step in the direction of safety for mining work.

When the three-phase system of distribution is adopted the circuits should be made and broken under oil, so as to render it quite impossible for gas, or coal dust to be ignited by an electric spark, and for direct-current distribution, explosion-proof chambers are necessary. Direct-current circuits cannot be broken under oil, as the gererator maintains the pressure constantly during the opening of the circuit. There is generally a tendency for the arc to persist, which is not present in an alternating-current circuit, where the pressure actually passes through zero a number of times per second, depending, of course, upon the periodicity. It should be pointed out that when a direct-current circuit is repeatedly broken

in oil, it is gradually carbonized, its insulating properties then diminish and ultimately disappear altogether. It follows that breaking circuit under oil is only suitable for the alternating current; at present it is the best system known, but for underground work something better may, in due course, be worked out. For both systems, an explosion-proof chamber for breaking circuit is suitable. From what has been stated above, it will be evident that the three-phase alternating-current system is the most suitable for underground work. Passing on to cables, which ought to be armored so that current can be automatically cut off as soon as leakage begins, there are two possible sources of danger: ignition of gas, or coal dust and of shock. The latter may arise from the not infrequent falls of roof, which will not generally affect armored cables. The insulation is very liable to damage with unarmored cables and then all telephone wires, signal wires and haulage ropes are possible sources of danger. The armoring must, of course, be well grounded, or its main advantage is lost. It may, of course, occur, under exceptional circumstances, that one of the cores will come into contact with the armoring through injury or crushing of the insulation; then a preventative device, either a fuse, or an automatic cut-off will make the circuit dead. Armored cables are not so liable to be severed by shock, or the rough usage of underground workings. There is consequently smaller possibility of an arc appearing external to the cable. Suitable ground for the cable armoring can be found at both the top and the bottom of the shaft and, if it is continuous, efficient earth for the most distant apparatus is provided. It is to be regretted that armored cables are not in use everywhere. That they are more costly than unarmored may account for the preference shown to unarmored. Even with armored cables, there should be a large margin of insulation, a length taken any where should not break under an alternating pressure four times the working pressure between any two cores, or between any one and the armoring. Specified pressure tests should always be insisted on by engineers.

For underground work, the switchgear should be provided with an earthed metal outer casing, so accidental contact with live parts would be impossible. The casing should keep out all dust, dirt and moisture and the whole should be fire-proof. Air-break switch-boxes and fuse-boxes should have gas-tight and flame-proof joints, so that inflammable gas cannot enter them. Gas-tight joints should have wide flanges. When accidents occur they are not due to the use of electricity, but to faulty designed apparatus, defective joints, careless supervision and a general want of expert knowledge. The three-phase squirral-cage motor is preferred by experts, as there are no rubbing contacts for current-carrying parts, consequently sparking is impossible. Incoming cables should be jointed to short cable lengths extend from the motor case. Oil-immersed transformers without exposed live terminals, are also essental; the frames of both should, of course, be earthed. Protected and open wiring for lighting are available, the former formed of a strong steel smooth-bored pipe, with insulated internal casing containing the wires, and the latter open-type wiring carried on porcelain insulators. Each is useful under suitable conditions below ground. The open system may be applied where it is dry, as at the shaft bottom, or in well-built motor houses where no fall of roof is possible, and the protected system where mechanical damage is possible, in haulage roadways, where it is damp and so on.

Turbo-Electric Generators for Marine Work.

A paper on "The Manufacture of Turbo-Electric Generators, and Some of Their Applications to Marine Work," was read by J. K. Patterson-Smith at a recent meeting of the Liverpool Engineering Society. The author, after briefly reviewing the possible applications of turbo-electric machinery to the propulsion of ships, said the chief advantages of electric drives were: (1) Practically no limit to power; (2) electromagnetic gear in place of teeth; (3) simple methods of varying the gear-ratio; (4) maintenance of efficiency over large range of power by subdivision of generators; and (5) no uncertainty regarding operation and life. Apart from questions of weight and economy, it was absolutely essential that the electric coupling should admit of an extensive range of speed control, together with effective reserving powers for braking and going astern while the vessel was being maneuvered. The types of machine available for propeller motors were: (1) Direct-current motors; (2) single-phase commutator motors; and (3) polyphase-induction motors. All of these could be arranged for variable-speed control. No important ship was at present being equipped in any of the many ways that had been proposed for the attainment of speed reduction with electric machinery. It was generally agreed that the characteristics of induction motors would meet the requirements of all vessels except those in which exceptional maneuvering capabilities were required.

Important advantages were claimed for the direct-current system in the form of flexibility, both regarding speed and torque, to meet the requirements of the vessel. The propeller motors could be built of any size, provided the voltage was increased with the size of the unit. Some of the largest electric motors yet constructed were of the compensated direct-current interpole type. With this type of motor, speed control was easily obtained by variable-voltage generators, motor-field control, and compound winding on motor field. For stopping the ship, the motors, being driven by the propellers, might be allowed to regenerate and deliver the energy to the main generators, where it would be absorbed either by some form of water-cooled brake or steam-blade brake. Another method available for braking was to dissipate the energy by means of resistances. Although propeller motors of large power presented no difficulty, it was found on investigation that direct-current turbo-dynamos, as at present constructed, were the limiting feature.

There is practically no limit to the size of polyphase generators, and this suggested the use of large two-pole, two-phase or three-phase generators, giving, if 1,000 revolutions per minute was a favorable speed, a frequency of sixteen and two-thirds cycles a second, which was a suitable frequency of supply for single-phase commutator motors. Such a system was proposed by the Oerlikon Company, and the author understood that they were prepared to construct motors of from 2,000 to 3,000 horsepower, continuous rating. It appeared that there was no great difficulty in manufacturing compensated repulsion motors of large size, the Winter-Eichberg motor having already been built up to 1,200 horsepower. In this system the principal difficulty would be with the propeller motors, instead of with the generating sets, as was the case with the direct-current system.

GASSING OF STORAGE BATTERIES.—What causes the strong bubbling of gas in storage batteries during charging?—R. C. J., Vicksburg, Miss.

The bubbling or, as it is technically called, "gassing" of storage batteries is caused by the decomposition of the water in the electrolyte into its constituent gases, hydrogen and oxygen. This decomposition sets in after the charge is somewhat advanced and becomes more and more noticeable as the charge nears completion, especially if the same current strength is maintained throughout. At the beginning of charge the energy of the charging current is used in decomposing the lead sulphate on both the positive and negative plates. As the percentage of lead sulphate diminishes, an increasing portion of the charging energy is expended in the liberation of hydrogen and oxygen from the water, the former being set free at the spongy lead (negative) plates and the latter at the lead peroxide (positive) plates. The bubbles of gas at the surfaces of the plates increase the internal resistance and the counter-electromotive force of the cell and therefore represent wasted energy; they are one of the chief causes for the energy efficiency of a storage cell seldom exceeding seventy-five per cent. Gassing is frequently, but erroneously, regarded as a sign that a storage cell is fully charged; the specific gravity of the electrolyte is a much more reliable indication. This does not mean, however, that violent gassing is a necessary feature of charge. In fact, on the contrary, strong gassing usually means a loosening or even disintegration of the active material of the plates by the expansion of the bubbles in crevices of the active material. Its deleterious effects can be minimized by "tapering" the charge, that is, by employing more than normal charging current at the beginning and reducing it gradually by steps as the charge proceeds.

LOCATION OF REVERSED COILS; LOW-VOLTAGE SYSTEMS.—(1) What is the best way to locate a reversed coil on a direct-current generator? (2) Are low-voltage plants coming into constant use and what advantages have they?—J. C. G., Aberdeen, S. D.

(1) The simplest way to test for reversed field coils is by means of two stout nails or short iron rods. Close the field circuit and apply the head of each nail to adjacent pole pieces. Bring the points of the nails slowly together and note whether they are attracted or repelled. Test each pair of poles in this way. The nails should in each case be attracted because adjacent poles should be of opposite polarity. If there is repulsion between a pole and its neighbors, it shows that the coil on that pole is reversed. (2) The second question is not very clear. Assuming it to mean the use of less than 110 volts for light and small-motor circuits, the tendency is to continue this as the standard voltage for secondary distribution, departing from it only for low-voltage tungsten sign lamps, for which an auxiliary or auto-transformer reduces the voltage from 110 to whatever is chosen. There was some agitation in favor of the general use of low-voltage tungsten lamps because these were more rugged than 110-volt lamps. The latter are so successful now, however, that there is little advocacy of low-voltage lamps outside of sign and railroad-train lighting where they have proven peculiarly suitable.

TIME SWITCHES FOR MULTIPLE STREET LIGHTING.—On several occasions I have noticed men going from one to another of the tungsten lamp-posts on one of the principal West Side streets for the purpose of lighting them. Could not the entire circuit be switched on at once, as in regular series lighting, or by means of a time switch, if a multiple circuit is used?—B. A. K., Chicago.

The lighting probably referred to is the special street lighting by means of ornamental tungsten clusters. Where these have not been installed with perfect regularity of spacing, as is true in Chicago and many other places in which the matter has been left to the option of the merchants entirely, it has been customary to put these lamps on the regular multiple system and to light and extinguish the individual clusters by hand. This has been found advantageous in that it eliminates the need for special circuits direct from the station and at the same time provides a patrol twice a night on the condition of the lamps. It is important in such special lighting that burned-out lamps or broken globes be promptly reported. Where the number of lamps to be provided for is so uncertain as it is when it depends on the efforts of solicitors only and when only a few lamps must be lighted directly after the first contracts are secured, a series circuit is undesirable. A multiple circuit is therefore almost always used. In a few instances remote-control switches governed from the station are provided; in others time switches are used for controlling long sections of the streets. The latter require periodic attention and have not been successfully developed to meet the general requirement that the lamps be extinguished at about 10 p. m. on six nights of the week and at midnight on Saturday. If the lamps burn each night till midnight or all night, the time switch with supervision once a week would probably meet the conditions satisfactorily.

THE MOST POWERFUL STEAM TURBINES.—I read a few days ago about a steam turbine having a power of nearly 20,000 horsepower and that even this was now being exceeded. Where are these larger machines in use?—W. C. C., Detroit, Mich.

Quite a number of the powerful turbines referred to are now in use in the leading American central stations, including that of Detroit. These machines have a maximum continuous rating of 14,000 kilowatts, which makes the turbine about 20,000 horsepower. There are now being built several turbo-generators to have a rating of 20,000 kilowatts in continuous service, the turbines having, therefore, a rating of over 28,000 horsepower. The first of these machines is being installed at the new Northwest Station of the Commonwealth Edison Company of Chicago.

New Electrical and Mechanical Apparatus and Appliances.

Air-Cooled Choke Coils.

It is sometimes convenient to mount choke coils on ceilings so that the insulating coil supports hang pendant and at other times it is preferable to arrange them so that the coil rests on the supports, as shown herewith. The new Westinghouse DI coil can be mounted either way, because the insulating columns can be removed and inverted by taking out four bolts.

An aluminum rod, bent into a helix of about fifteen inches diameter and containing about thirty turns, forms the coil proper. Bracing clamps are provided to give mechanical strength to the

AIR-COOLED CHOKE COIL.

helix. The aluminum rod used is of sufficient diameter to safely carry 200 amperes.

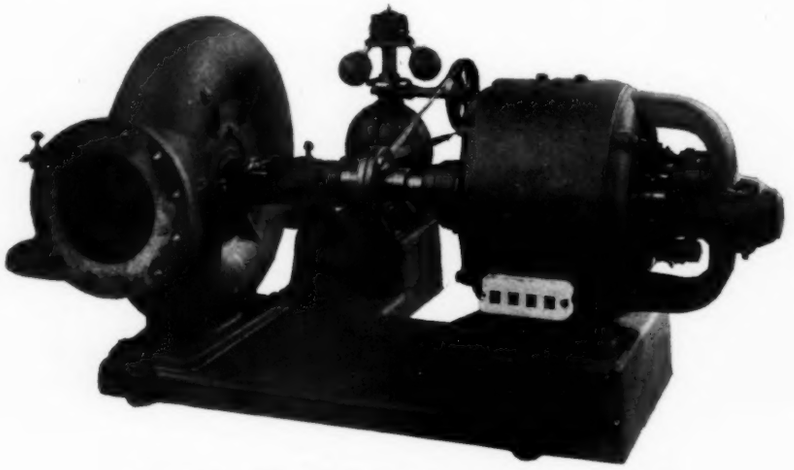
Each coil is supported on two insulating columns made up of porcelain insulators, which, except for the end pieces, are interchangeable. The number of insulators used in any column depends on the voltage of the circuit in which the coil is to be used.

Type DI coils can be mounted in any position convenient for the wiring, on the floor, wall or ceiling. For floor mounting, the parts are arranged as shown above, and for inverted mounting the insulator columns are inverted and the base attached to the ceiling. The insulating columns are supported on substantial cast-iron blocks fixed on wooden bases.

These choke coils are intended principally for the protection of transformers and should not be used for generators. Where greater reactance than is afforded by a single coil is desired for the higher-voltage circuits, it is recommended that two or more coils be connected in series.

Victor Turbines.

The Platt Iron Works, Dayton, O., has made a number of important changes in the details of construction of its Victor turbines in order to meet the demand for a wheel which can utilize small amounts of water at the highest efficiency and ranging under heads from 5 to 50 feet. The accompanying illustration shows the complete wheel arranged for direct connection to a small electric generator. The speed of this unit is controlled by a governor which can be replaced by a hand wheel if desired.



VICTOR TURBINE DIRECT CONNECTED TO GENERATOR.

The wheel unit comprises a small water-wheel runner mounted in a circular housing on a horizontal shaft, the water entering the housing from either the top or side, and is directed onto the rotor, or runner, by means of rectangular nozzles. The water passing through the gates and through the runner is discharged into the tailrace or discharge pit through a draft tube.

The unit rests on a heavy bed plate extending beyond the wheel to support a generator-bearing for a pulley or other machine, as the case may be. The runner is made in one piece, a cored casting of bronze, which contains the necessary number of buckets having the proper angles and thickness to insure ample strength and economical operation. All the exterior surfaces are machined, and the internal faces are hand cleaned. The runner is bored and keyseated to insure a correct fit on the shaft.

The housing is made in one piece and is a cored cast-iron casting, circular in form. A standard flanged inlet is provided either at the top or side as desired. The drilling of this flange is standard. The interior of the housing is carefully machined to receive the chutes and gates and for the discharge elbow. Heavily ribbed feet, cast on the housing, provide a rigid support and connection to the base plate.

Austrian Lamps in Japan.

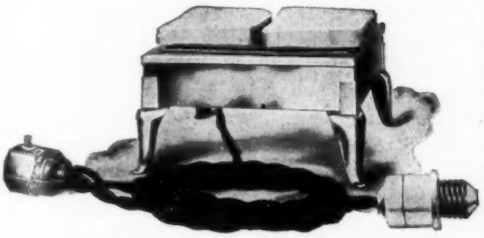
The United Incandescent Lamps & Electricity Company, Buda-Pesth, Hungary, has been requested by the Japanese Government to establish a manufactory for incandescent lamps in Japan. The company will send an engineer to that country.

Electrification of Copper Rolling Mills.

The copper rolling mills of Vivian & Sons, near Swansea, Engand, are to be driven by two 300-horsepower electric motors, running at 150 revolutions per minute. A 1,000-ampere storage battery will be provided for equalizing the load.

Combination Electric Stove and Toaster.

In summer, the disagreeable and laborious character of flame cooking becomes most pronounced, and it is in that season when the smoke, the heat and the bad odor are most in evidence. It seems, therefore, that the summer months offer the central-station manager an unusual

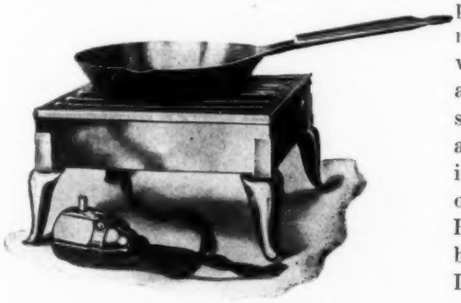


HUGHES' STOVE USED AS TOASTER.

opportunity to push the sale of the electric stove and incidentally acquire a profitable load.

A moderate-price stove which combines the advantages of the electric toaster and the general utility stove is now offered by the Hughes Electric Heating Company, Chicago, Ill., and should prove particularly suitable for introducing the merits of electric cooking, the advantages and economies of electric toasting already being known.

The accompanying illustrations show the stove when used for toasting and when used for cooking. It is four inches high, six and one-fourth inches wide and seven and one-fourth inches long. It weighs three pounds and can be attached to any lighting circuit, being made for all commercial voltages. The



HUGHES' ELECTRIC STOVE.

stove is very attractive in appearance, all parts being nickel plated. The legs can be easily removed and the stove carried in a suit case, a convenience much appreciated by travelers.

The heating element of this stove, as in all Hughes stoves, is made of a special composition. The wire is a patented alloy which is said to be non-corrosive under all conditions of service. The base of the heating element is 8.5 inches in diameter, and it may be easily taken out for cleaning or renewing the coils. The current consumption of the combination stove and toaster is 500 watts.

New Feed-Through Switch.

A feed-through switch is usually employed with portable heating devices such as soldering and branding irons, etc., and with small motor-driven devices as drills and vacuum cleaners. It is installed on the cord near the devices controlled so as to facilitate closing and opening the circuit wherever the device is used. A switch used for this service, especially in industrial plants, should be capable of withstanding a considerable amount of hard usage.

CUTLER-HAMMER FEED-THROUGH SWITCH.

The new Cutler-Hammer feed-through switch shown in the accompanying illustration has an inclosing casing made of a new insulating material, which is the result of years of experimental work. This material is remarkably tough, and can be moulded with extreme accuracy so that perfect alinement of the operating parts is possible. The rating of this switch is six amperes, 125-volts, and the mechanism is the same unique and now well-known one which is used in the other Cutler-Hammer specialties. The switch has been approved by the Underwriters Laboratories.

A Large Circuit-Breaker.

A circuit-breaker having a capacity of 12,000 amperes was recently shipped to the Southern Power Company by the General Electric Company. It will be used on the 600-volt side of 11,000-600-volt, 6,600-kilowatt frequency-changer set. This circuit-breaker is said to be the largest capacity alternating-current breaker ever manufactured.

The Application of Guy Anchors Under Difficulties.

In many cases where it is necessary to guy poles, property owners refuse to allow anchors to be located on their property, thinking that in every case holes must be dug which would mar or

FIG. 1.—MATTHEWS' GUY ANCHOR IN PRIVATE FLOWER BED.

destroy their lawns, gardens, etc. The two accompanying illustrations show installations of Matthews guy anchors on private property where the owners agreed to the installation only after being convinced that no hole digging was necessary.

Fig. 1 shows the use of a No. 603R Matthews guy anchor by a St. Louis company in a private flower bed where anchorage was obtained only on the condition that no hole was to be dug and that the surrounding foliage was not to be disturbed.

Fig. 2 shows a No. 800 Matthews guy anchor which was located alongside a fence in order to be in the company's right-of-way. This anchor is one of an installation of ten which have been in

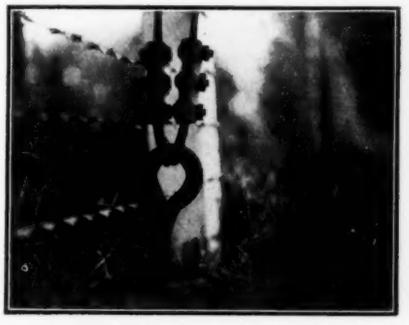


FIG. 2.—GUY ANCHOR INSTALLED ALONGSIDE FENCE.

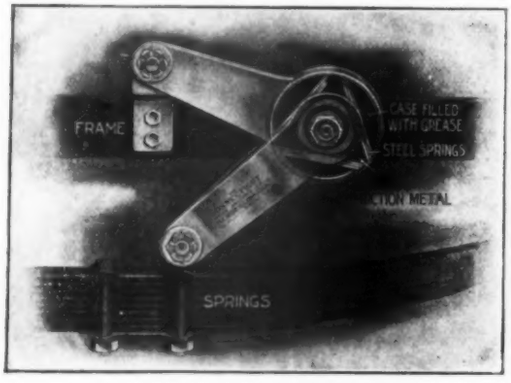
the ground for over four years and at times hold a maximum strain of over 10,000 pounds. These anchors were installed with a special ratchet.

These anchors are manufactured by W. N. Matthews & Brother, St. Louis, Mo.

A Unique Selling Policy.

The Connecticut Shock Absorber Company, Meriden, Conn., manufacturers of shock absorbers for automobiles, has for several months past followed an original selling plan which is said to meet with a good deal of response from motorists. The shock absorbers are sold installed on the car; in other words, there is no charge for attaching.

This plan, which incidentally solves the problem of correct installation on a car, is carried out through the aid of Connecticut "Shock Absorber Installing Stations," which take care of this work in the territory which they cover. The work of installation is thus accomplished under the indirect supervision of the home factory. It not only relieves the dealer from responsibility to his customer, but what is more, it takes the burden back on the manufacturers, who, through the installing station re-



CONNECTICUT SHOCK ABSORBER.

assume direct responsibility to the customer.

An Electric Jewel-Box Alarm.

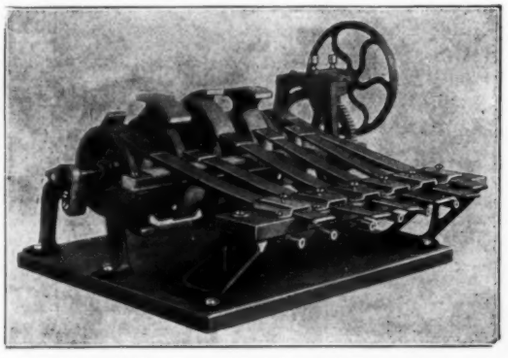
According to a recent consular report, a useful invention in the way of a cash and jewel box with an electric alarm attachment has just been placed upon the market in Paris, France. This alarm box is said to be the invention of Paul Weber, of Vienna, Austria, and is covered by patents in several countries of Europe as well as in the United States.

The invention, briefly described, is as follows: In the bottom of the jewel box is placed a small mechanism consisting of a dry battery, a magnet, and a system of levers, the whole forming a device which may be energized by moving a small lever fixed and concealed in the side of the box. The sound is made by means of a bell and clapper similar to those on a telephone instrument. In the center of the bottom of the box is a small orifice, through which hangs suspended a small pendulum. As long as the box is stationary this pendulum hangs perpendicularly and does not close the electric circuit. But if moved only in the slightest degree one way or the other, or if the box is raised off the table, the pendulum drops down, thus closing the circuit of the electrical mechanism and causing the alarm to sound. It makes a noise as loud as an alarm clock and does not cease ringing until it is shut off. This can only be done by opening the lid of the box and shifting a lever. It would, therefore, be a noisy article for a would-be thief to attempt to steal.

A New Heavy Brush-Type Flasher.

The accompanying illustration shows a heavy brush-type machine, recently placed on the market by the Reynolds Dull Flasher Company, of Chicago. This type of flasher is recommended for high-speed work, where there are more than 160 lamps in a job, or any work of a similar heavy capacity. For instance, 320 lamps on a high-speed effect in the past would have required a No. 16 high-speed flasher, using seventeen wires. At present, instead of supplying a machine with this number of switches, a heavy brush type is used, containing four switches, and requiring but five wires. It will readily be seen from this that there is a great saving in wiring to say nothing of the cheaper cost of the latter machine. The larger the size the greater the saving proportionally. This machine has a capacity of twenty-five amperes at 110 volts or 100 five-watt ten-volt tungsten lamps per switch.

The cams used are six inches in diameter, one-inch face and three-eights of an inch thick on the wearing surface. The brushes are ten inches long, one inch wide, and consist of six leaves of pure drawn copper. It has machine-cut gears, steel worms, and is substantially built throughout. Its simplicity seems to have recommended it to a great many users.



BRUSH-TYPE SIGN FLASHER.

Black Desk Stands More Popular than Nickel-plated Ones.

As far back as 1908 the engineering repartment of the Western Electric Company began a series of experiments and tests to find a more serviceable finish than nickel for its desk stands. The nickel-finished stand was not proving entirely satisfactory owing to its tarnished and brassy appearance after a comparatively short period of service. In addition, the cost of refinishing was high.

These tests were carried on continuously for the next two years and during that period sample stands were made up finished in enamel, celluloid, agate, rubrubber paint, rubber japan, etc. After these stands had been subjected to rigid tests to determine their value under all conditions of service, it was found that the rubber-japan finish was the most satisfactory.

During 1909 the demand for this stand steadily increased as it was found not only to equal the nickel stand in life, but in addition, to present a better appearance while in service. Furthermore, there was a considerable saving in the cost of maintenance. In 1909 the sales of the black-finished stand represented only 40 per cent of the total output; by the end of 1910 the demand had risen to 63 per cent and during the first three months of 1911, 81 per cent of orders called for stands having the new black finish.

BLACK-FINISHED DESK STAND.

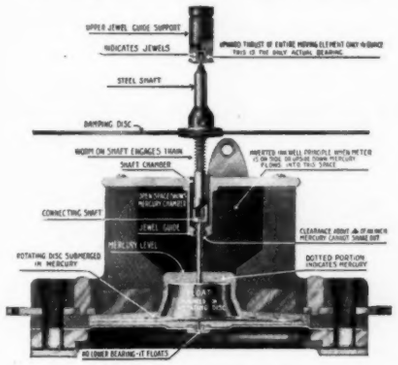
Trip-Reading Watt-Hour Meter.

In the Sangamo street-car meter shown in the illustration, the armature floats in the mercury in which it is immersed, a small solid non-metallic float being riveted to the center of the copper disk in order to give the necessary lifting effect for the weight of the entire moving system. By properly proportioning the amount of buoyancy or upward thrust produced by the immersion of the armature and its float in mercury, a very light pressure, about three grams, is exerted on the jewel bearing at the top, thereby rendering the meters absolutely proof against the jars and shocks of railway service without danger of injuring the moving system or jewel bearing.

The variation in the amount of effective pressure upon the jewel between a temperature of 110 degrees above zero and ten degrees below zero Fahrenheit, due to change of density of the mercury, is not sufficient to show any appreciable difference in the buoyancy. The large ring jewel surrounding the inner spindle where it passes through from the mercury chamber and the small ring jewel at the top of the outer spindle guiding it where it presses upward against the flat-end jewel at the top have so little friction upon them that the wear is inappreciable and breakage of these jewels is an unknown quantity.

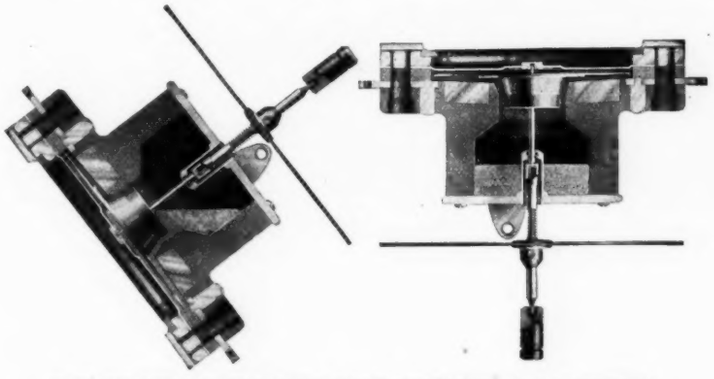
It will be quite evident from an inspection of the motor element that the armature acts like a plunger in a dash pot filled with very heavy liquid, so that it is impossible for any sudden jar or shake to be transmitted to the jewel bearing in such a way as to produce an excessive strain upon it. The mercury-chamber element is designed somewhat like an invertible ink well, so that it is impossible to spill mercury no matter in what position the meter may be turned or placed in shipment, or at the time of installation.

The shaft of the meter is made in two parts, the lower one, which carries the armature, passing up through the sapphire guide ring in the long shell projecting down from the cover of the mercury chamber, while the upper and larger shaft, which carries the damping disk and the worm for driving the recording train, is keyed freely to the lower shaft, being thus properly driven from the armature. The ring-jewel guide is very accurately gauged to give a clearance of about .001 to .002 inch on the armature shaft.



SANGAMO MERCURY ELEMENT.

The non-spillable feature of the mercury flotation meter coupled with its inherent ruggedness renders it especially desirable for use in street-car service which inevitably subjects the meter to excessive shocks and jars.



MERCURY-MOTOR ELEMENT HALF INVERTED AND INVERTED.

Announcement was recently made that the Ely interests, composing a syndicate connected with Drexel, Morgan & Company, have invested $1,000,000 in electric trolley, light, heating and power plants in and around Washington, Pa.

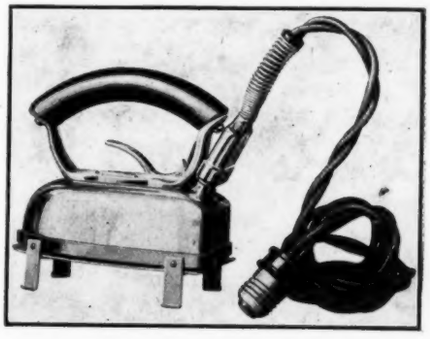
Traveler's Electric Iron.

Often the traveler has occasion to do light pressing in his or her room. Creases in garments, that come from packing, must be eliminated, the effects of damp weather must be removed and often dainty linen must be pressed. An electric iron is invaluable for these services but, for the traveler, an iron should be so designed that it can be packed readily and it must be thoroughly reliable.

The Westinghouse Electric traveler's iron, which is shown herewith, has three qualifications. The handle can be removed so that a minimum of packing space is necessary. The heating element is inclosed, under enormous pressure, between the bottom ironing face and a top casting which constitutes a heat reservoir and which is thermally insulated from the sheet-metal cover by an air space. This construction prevents oxidization of the element, hence it will last indefinitely.

A noteworthy feature of the Westinghouse traveler's iron is that no breakable material enters into its construction. Porcelain, lava, or moulded asbestos, all of which are brittle, are sometimes used in electric irons, or in the connecting plugs. None of these materials is used in the Westinghouse iron or in its plugs. All insulation is of sheet mica.

A hole is provided in the end of the traveler's iron in which a curling iron can be heated. A durable stand, formed from sheet metal, is furnished with each outfit.



WESTINGHOUSE TRAVELER'S IRON.

An Electrically Propelled Collier.

The naval collier *Jupiter*, which is being built at the Mare Island Navy Yard, will be driven by motors supplied with power from turbine generating sets. A considerable gain in economy of operation is expected.

Electrics Perform Well.

The electrical and mechanical characteristics of the high-grade electric vehicle of today have been brought so close to the ideal that there will be little incentive to replace it five or ten years from now with one having slightly better characteristics.

In order to keep the fixed running charges of a delivery system as low as possible, it is essential that vehicles having the most economical characteristics are used, but true economy can only be obtained by using vehicles which combine with efficient operation a minimum depreciation charge against the investment. The proper amount to be charged against depreciation, (whether it shall be 5, 10, 15 or 20 per cent), can only be determined after the "worn out" point has been reached, unless vehicles which, under actual operative conditions, have demonstrated their lasting qualities are purchased.

The hundreds of General Vehicle Company's electric vehicles, operating under all possible conditions of service have demonstrated that these machines are built to last. The General Vehicle electrics of today are much different from the first one put on the market, in the experimental stage of the industry. Improvements of many characters have followed each other at frequent intervals, but the same underlying principles that made the first General Vehicle machine successful have been persistently adhered to. This vehicle has always been built, not for startling operating characteristics alone, nor with first cost as a primary factor, but to do its work with minimum depreciation; in other words, to last.

The Engberg Electro-Hydraulic Valve.

A gate valve for awkward places has been put on the market by the Engberg Electric & Mechanical Works, St. Joseph, Mich. It is operated electrically by current supplied from local batteries.

The valve is operated by a hydraulic cylinder, which is supplied by water from either side of the gate. The regulating valve consists of a flat valve which is operated by a piston. The Piston is moved by releasing the pressure on either side by means of small poppet valves which are raised from their seats by an armature and magnet. A bell circuit is included to enable the switchboard operator to ascertain the position of the gate.

The valve can be operated by hand simply by lifting the small armature on the controlling device. Dampness will not affect this valve and it can be placed in any position.

Lehigh Valley Extends Its Telephone Train-Dispatching System.

The Lehigh Valley Railroad, which already has a large percentage of its system equipped with telephone-dispatching apparatus, has just placed an order with the Western Electric Company for similar equipment for use on the east end of its Buffalo Division. When this equipment is installed the Lehigh will have all its main line between New York and Buffalo equipped for telephone train dispatching except a short strip on the West Buffalo Division of less than ninety miles, and it is expected that in the near future this section will be similarly equipped.

On the new circuits just ordered several new ideas will be carried out. The line itself which is now under construction will be of 210-pound copper wire and its arrangement will be different from any now in use. The wire will be located on the top crossarm, which will make it necessary to rearrange the present telegraph circuits. Experience with the telephone circuits which have been in use for the past year on other sections of the road, however, indicates that the saving in maintenance will more than justify the additional expense of this arrangement.

The main line over which the dispatcher handles trains extends from Sayre, the dispatcher's office, to Manchester Yards, a distance of eighty-six miles. At Van Etten Junction, the Ithaca branch leaves the main line, meeting it again at Geneva. This branch, including a five-mile branch to Willard, is eighty miles in length. At Geneva there are two branches, one to Naples, twenty-nine miles long, and one to Seneca Falls, ten miles long. This makes the total length of the circuit approximatey 208 miles.

Forty-eight local-battery, Western Electric selectors will be used on this system. The sending-key cabinet will be so arranged that when a dispatcher is calling stations on the main line, current will not be sent out on the Ithaca branch. This arrangement makes it possible to use but half the voltage necessary to operate the whole circuit, and this will effect a material saving in maintenance.

Change in Sprague Electric Company.

On June 1, 1911, the Sprague Electric Company will be merged with the General Electric Company, of Schenectady, N. Y. Its business will be conducted under the name Sprague Electric Works of General Electric Company.

The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Company will be continued by the Sprague Electric Works of General Electric Company under the same organization, with D. C. Durland in responsible charge as general manager. All correspondence should be sent to the Sprague Electric Works at the same address as in the past. Bills and statements will be rendered from the Sprague Electric Works, 527 West Thirty-fourth Street, New York, N. Y., to whom all remittances should be made. The offices at this address will be continued as heretofore, as also the branch offices in many cities.

Starter for Electric Motors.

A starter for electric motors has recently been put on the market in which each element is a little boxful of granular graphite under a certain degree of compression. The thermal capacity is considerable, and a high starting temperature alone could not make a break in the circuit. That does not end the possibilities of a graphite powder that has a certain degree of compression and a steady temperature coefficient.

Arranged in a series of self-contained cells of light, springy metal, each slightly compressible, it makes a resistance that can be minutely graduated by altering the compression on the pile. Arranged in this way with a compress a screw and a small hand wheel the principle has been applied to field regulators.

Electric Safety Lamps for Miners.

An article on this subject in a recent issue of *Electrical Engineering* points out the numerous advantages of electric safety lamps for use in mines over the long standard Davy safety lamp employing oil. The prediction is made that the electric lamps will in six or seven years have entirely replaced oil.

O-B Thermo-Bonding Process.

The O-B thermo-bonding process is a simple, economical, rapid and effective method by which the terminals of standard O-B all-wire compressed terminal rail bonds can be soldered to the rails after being compressed by the O-B compressor in the ordinary way, thus combining the great permanent conductivity afforded by soldering both head and stud of the terminal with the well-known mechanical strength and positive application obtained by compression.

The extra tool equipment and materials required are simple and low in cost. The entire operation can be performed by one man in a very few minutes and it has been found possible to apply bonds by this process on roads having a two-minute headway without delaying the traffic.

The process consists of heating the bond terminal, after compression, and the adjacent web of the rail practically instantaneously, independent of cold or windy weather conditions, by a chemical reaction. The heat produced is so concentrated that while the terminal and the adjacent web are quickly brought to a soldering heat the ball of the rail remains so cool that the hand can be laid upon it while the soldering is being done so that no injury to the rail or to the body of the bond can possibly result. The solder enters at "C", Fig. 4, under the shoulder "B" of the terminal and firmly unites the entire shoulder "B" to the web of the rail, forming a fillet at "C" and thus positively sealing the joint against the entrance of moisture between the head of the bond and the web of the rail and uniting the compressed portions of the terminal to the annular walls of the hole in the rail.

The result is a greatly increased permanent contact area (B) and the positive sealing of the entire joint against moisture and corrosion so that the initial high conductivity thus obtained will be maintained without depreciating for an extremely long period of time under service conditions.

This process, which is equally effective for both new bonding and rebonding work, is patented by the Ohio Brass Company, Mansfield, O.

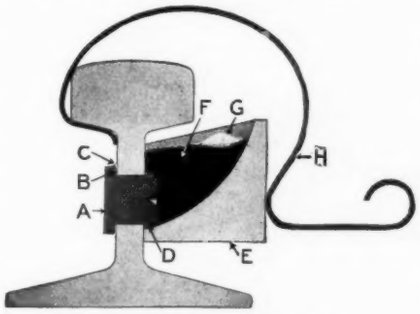


FIG. 4.—SECTIONAL VIEW.

Feval Enamel Insulated Wire.

Numerous desirable characteristics are embodied in the wire products of Feval Enamel Insulated Wire Company, of 122 North Curtis Street, Chicago, manufacturers of enamel insulated magnet wire, coils and coil windings of every description.

It is claimed for the Feval enamel insulation that it has higher dielectric strength than silk or cotton insulation, will withstand more heat without deterioration and is imprevious to chemical action and moisture. It occupies less space than silk insulation, therefore its use means saving of space in the apparatus in which it is employed. The company states that the weight of its enamel insulating being much less than fabric insulation, an average gain of approximately twenty per cent in length per pound results from its use.

These facts are brought out in a test of Feval enamel by the Armour Institute of Technology (Chicago).

AN EFFICIENT GAS-ENGINE INSTALLATION.

BY W. G. SHROM.

In the great advance which has been made in all lines of engineering during the last decade and the increased efficiency that has been attained with all types of prime movers, one of the most important considerations has been the elimination of waste. One of the ways in which this has been accomplished in the power house has been to prevent the loss of heat from boilers, piping and cylinders. In refrigerating establishments the reverse operation, or the prevention of the ingress of heat, has been the main object in view. This has been accomplished by covering pipes, and building cold-storage rooms with walls of suitable material. Cork has been found to be the best suited for this purpose by the Armstrong Cork Company, whose plants are located at Camden, N. J., and Beaver Falls, Pa. The aim of this article is to tell of the improvements made in the latter plant.

The Beaver Falls plant of the Armstrong Cork Company covers about twelve acres. The machines for the most part are driven by belt from line shafts, which in turn are driven by motors or small gas engines. There are eight of these small engines varying in size from 75 to 100 horsepower each. There are about fifty motors varying from 10 to 30 horsepower each. The eight gas engines drive the machines which operate continuously, and the motors are more especially used to drive the machines which operate intermittently, some motors being belted direct to the machines and others to line shafts. Current is delivered to them through a 200-volt feeder system which radiates from the power house. The switchboard in itself is an index of the growth of this

FIG. 1.—READY FOR IGNITION.

FIG. 2.—DURING REACTION.

FIG. 3.—APPLYNG THE SOLDER.

plant. The one feeder panel installed a number of years ago contained six feeder switches, each of the six feeder lines running to a single motor or a very small group of motors, having a maximum capacity of 200 amperes. A new feeder panel has recently been added to the switchboard, this panel having mounted on it four 800-ampere switches and two 600-ampere switches, and each of these controls not a single motor, but the supply to a distribution board in one of the various buildings. In addition to the six feeder switches the new panel contains a recording wattmeter. Formerly power was supplied for both lights and motors by two direct-connected steam units, one having a capacity of 75 kilowatts and the other 125 kilowatts. Both these engines are four-valve high-speed machines. These were supplied with steam from an adjoining boiler room.

The building for the power house was erected a number of years ago. The foundations are of concrete and the walls of yellow brick, making a very attractive structure. A yellow-brick wall separates the engine room from the boiler room, each of these being approximately 50 feet long and 40 feet wide, the building itself being approximately 80 feet long and 50 feet wide. The boiler room contains one 500-horsepower and one 300-horsepower Babcock & Wilcox water-tube boiler, these being built for 160 pounds working pressure and supplied with chain-grate mechanical stokers. The boiler room also contains steam pumps for fire protection and direct-acting boiler-feed pumps and a feed-water heater.

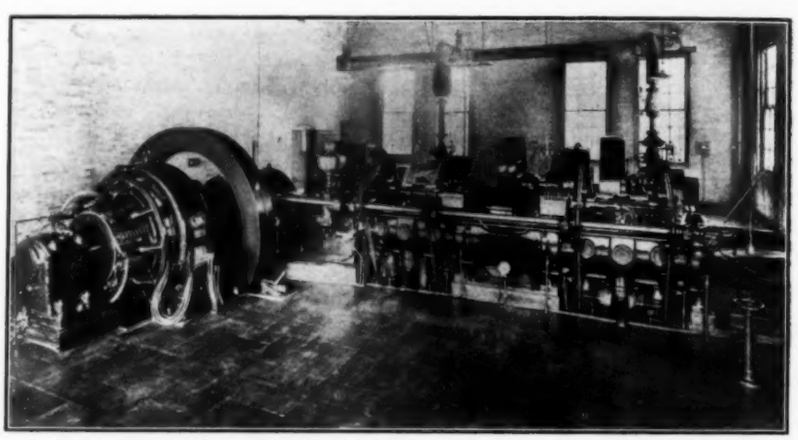
It is extremely interesting to note that this steam plant has been displaced by a gas-engine unit recently installed and now serves as an auxiliary plant, the smaller unit being still used for furnishing power at night when the load does not exceed about 60 kilowatts. This is especially noteworthy in view of the fact that it is necessary to maintain a steam pressure of 125 pounds on the boilers 365 days in the year. It would seem that under the conditions existing, a steam plant was the logical plant to be used, especially as coal can be secured very cheaply in this territory. In spite of all these favorable conditions the Armstrong Cork Company found it to its financial advantage to install a gas engine which operates from 7 a. m. to 6 p. m. This has the same capacity as the two steam units which now stand idle during the day.

The new unit consists of a single tandem double-acting gas engine direct-connected to a 200-kilowatt, direct-current generator and was furnished by Allis-Chalmers Company. Natural gas, having a heating value of about 900 British thermal units per cubic foot, is used as fuel. The cylinders, which are 18 by 24 inches, are cast of tough fibrous iron especially adapted to taking up the severe shocks experienced in gas-engine operation. The outer wall carries the mechanical stresses, while the inner one is subjected only to the working pressure of the gas. Each cylinder is provided with a liner of a special grade of very hard, fine-grained iron chosen particularly for its wearing qualities. This liner is secured in the cylinder by an ingenious construction consisting of a tongue-and-groove fit at its middle and a shrink fit over the rest of the surface. The forward cylinder is bolted to the main frame, which is of extremely massive construction, so designed as to absorb the shocks to the best advantage. The two cylinders are held rigidly in place by a heavy tie piece, which also carries the weight of the crosshead. At the rear of the second cylinder is a tail-piece which carries the tail-rod slide.

The valves, both inlet and discharge, are of the poppet type and the entire mechanism of each valve is carried in an independent cage. Four valves are provided for each cylinder, two inlet at the top and two exhaust at the bottom. The admission valves are of the stratification type with separate control of air and gas. The auxiliary gas valve opens after and closes before the air valve, thus preventing the accumulation of an explosive mixture in the inlet chamber. With natural gas a practically constant mixture is provided for all loads.

The pistons are each made in one piece of extremely tough cast iron. Each piston is fastened to its rod by being forced against a shoulder by a countersunk-nut threaded on the rod. This leaves a smooth face exposed and does not present any sharp edges to cause back-firing or pre-ignition. The piston rod of the engine is made in two sections corresponding to the two cylinders, and is coupled at the intermediate crosshead. This is to facilitate removal when necessary. The rod is bored hollow to provide for the circulation of cooling water through the rod and pistons.

Mechanically operated igniters are employed, which are supplied with current from a storage battery when starting and from a small generator on the engine during regular operation. Each end of each cylinder is fitted with two independent igniters arranged to operate simultaneously, thus insuring an explosion. The action of all the igniters can be simultaneously retarded or advanced by a single hand-wheel.



INTERIOR OF POWER HOUSE SHOWING GAS ENGINE IN FOREGROUND.

The air starting arrangement is quite interesting as the engine is regularly started in a very short time under an air pressure varying from 150 to 200 pounds. In each end of each cylinder is placed an air valve which is operated from the regular lay shaft. On opening the air-pressure throttle-valve the air pressure automatically throws the starting gear into engagement. Similarly the gear is disengaged when the throttle valve is closed. The valves admit air to the cylinders at a pressure corresponding to the working pressure for that position and this causes the engine to operate on its regular cycle.

The accompanying illustration shows the interior of the power house, with the gas engine in operation.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

A hearing, before the Public Service Commission, First District, began on June 1 to inquire whether the Edison Electric Illuminating Company of Brooklyn receives a greater compensation for electricity or service from certain favored parties than it does from others. Inquiry will also be made as to whether the company has charged a different rate of compensation for service than the rates and charges applicable to such service as specified in its schedules filed with the Public Service Commission and posted and in effect at the time. This action was taken following the receipt of complaint from certain consumers in Brooklyn that the company was giving better rates to certain consumers than to others.

The Public Service Commission, Second District, has authorized the Northern Wayne Electric Light & Power Company to purchase the franchises, works and system of the Wolcott Electric Light & Power Company in the village of Wolcott at $33,000.

The company is also authorized to begin and complete the construction of a pole line and equipment for the transmission of electricity from the substation of the Rochester & Sodus Bay Railway Company at Sodus, in the village of Wolcott and through the towns of Rose, Huron and Wolcott to the village of Red Creek, and from the village of North Rose to Rose. It may also construct secondary distribution systems in the villages of North Rose, Rose and Red Creek, all in the county of Wayne.

The company is also authorized to issue its capital stock to the par value of $75,000, the proceeds to be applied for the purchase of the Wolcott plant and the necessary construction of the lines authorized under its various franchises.

The Red Hook Light, Heat & Power Company and the Albany Southern Railroad Company were heard on Monday on applications for authority which will allow them to exercise franchises in Greenport, Columbia County.

The Red Hook Company seeks the assignment of a franchise which the town granted June 4, 1907, to Jonathan T. Rider. This franchise has not been exercised by said Rider and the Red Hook Company, which has a distributing plant at Red Hook, Dutchess County, and now serves Red Hook, Germantown, Livingston and Clermont with electricity, asks authority of the Commission to enter Greenport.

For some time past the Albany Southern Railroad Company has been furnishing electric current for light, heat and power purposes to residents of various towns along its railroad between Albany and Hudson. The franchise which it seeks to exercise was granted by the town board of Greenport on May 20, 1911. The terms of both franchises are practically identical in that they grant authority to the holders to erect necessary poles, and lay pipes or other fixtures for the conveying of electricity for public and private use for compensation.

The Red Hook Company also asks authority to exercise a franchise granted to Jonathan T. Rider by the town of Claverack, Columbia County, for necessary construction for the furnishing of electricity for light, heat and power in that town.

The Red Hook Company is also seeking to enter the territory of the Albany Southern Railroad Company in the city of Hudson and now has an application before the Hudson Common Council for a franchise to furnish electricity.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Commission is now receiving replies to the circular letter recently sent out to all the utilities in the state calling for a complete description of the accounting methods of each utility. The letter calls for forms to be submitted by each company showing the accounts kept and the manner in which the payroll and supply accounts are distributed. The information acquired by these letters is to be supplemented by personal inspection of the books of the utilities where such inspection appears to be necessary. The public-utility law requires that all utilities shall follow the classification of accounts prescribed by the Commission and the purpose of the circular letter is largely to check up the general observance of the law in these particulars.

The Janesville Traction Company has been empowered to issue 1,250 shares of common stock, of the par value of $100 each, and $50,000 of the par value of five-per-cent, thirty-year, first-mortgage bonds. The bonds are to be issued in denominations of $1,000 each. The total bond issue is to be in accordance with the terms of a mortgage or deed of trust executed by the company to the Banker's Trust Company of New York, as trustees. The stocks and bonds are to be issued for the purpose of taking over and acquiring the property, rights, powers, privileges, and franchises which the Janesville Street Railway Company had or was entitled to have at the time of the foreclosure sale which was had pursuant to a judgment of foreclosure and sale entered in the Circuit Court of Rock County on April 5, 1910. The property of the traction company, together with all rights and privileges, was purchased at the foreclosure sale by A. G. Hodenpyle, H. D. Walbridge and George E. Hardy, doing business under the name of Hodenpyle, Walbridge & Company. This company owns all of the outstanding bonds and 350 shares of the 500 shares of stock of the Janesville Street Railway Company, and has organized the Janesville Traction Company for the purpose of taking over the rights and privileges of the former company. The total issue of stock and bonds authorized by the Commission is to be issued to Hodenpyle, Walbridge & Company on the completion of the organization of the new company. It appeared from the petition in the above proceedings that the outstanding bonds of the Janesville Electric Railway Company at the time of the foreclosure amounted to $75,000, which with accrued interest made a total indebtedness of $164,754. The stock issue outstanding at the time of the foreclosure amounted to $450,000. In addition to this there was issued by the receiver under order of the court receiver's certificates to the amount of $10,000 for improvements. No valuation of the property was made by the Commission.

The Baraboo Gas & Electric Company has been authorized to issue 1,000 shares of stock of the par value of $100 each and $98,000 par value of bonds. The property, rights and privileges of the Baraboo Lighting Company were acquired by the Baraboo Gas & Electric Company through a foreclosure sale. The outstanding indebtedness of the Baraboo Lighting Company at the time of the foreclosure sale was $198,000; and the outstanding bonds were held by the incorporators of the Baraboo Gas & Electric Company. The City of Baraboo owns and operates a water-works plant, using hydraulic power. The city has been considering the construction and operation of a municipal electric plant and sought permission from the Legislature to go ahead with the project. The Senate refused the necessary permission in view of the established policy of the State to discourage competition of this nature. The newly organized Baraboo Gas & Electric Company will reconstruct and improve its electric plant and system and will generate electricity with hydraulic power, doing away with its present steam plant as the principal source of power.

Complaint has been made by twenty-five citizens of Lodi that the Lodi municipal plant is charging unreasonable and excessive rates for electric current for lighting purposes. The complainant also alleges discrimination in the application of the meter-rental provision. The hearing in the above matter will probably be heard in June. Informal complaint was made by the president of the Village Board of Park Falls that the rate charged to the village by the Park Falls Water, Light & Power Company for street lighting was excessive. The present rate is $100 per year for the first ten arc lamps installed and $90 per year for all lamps over ten. The service is from dusk to midnight.

LIGHTING AND POWER.

(Special Correspondence.)

GENTRY, ARK.—Harry V. Forest is about to construct an electric light plant here. P.

CORNELL, WIS.—Simon & Stewart have commenced the construction of a power plant. C.

CROWLEY, LA.—A new switchboard was recently installed in the local electric light plant.

VILLISCA, IOWA.—A vote will soon be taken on the installation of an electric light plant. P.

BELTON, MO.—As a result of a special election, a municipal electric light plant will be built here.

ANDERSON, MO.—Harry V. Forest, of Kansas City, Mo., will construct an electric light plant here. P.

NEW MARKET, IOWA.—The Lee Electric Light Company, of Clarinda, has been given a franchise here. P.

ALLEN, TEX.—The Allen Light & Power Company has been incorporated with a capital stock of $2,000. P.

NEWBERRY, MICH.—It is proposed to bond the village for $11,500 for the construction of a power plant. C.

FAIRFIELD, IOWA.—Paul & Adams, of Centerville, Iowa, will install improvements in the electric light plant. C.

MOBERLY, MO.—T. F. Fulkerson, of Trenton, Mo., has been granted an electric light and power franchise here. P.

DULUTH, MINN.—The Minnesota Canal & Power Company has plans for the development of a 600-foot fall of water. C.

BOONE, IOWA.—The Central Iowa Light & Power Company has been incorporated with a capital stock of $5,000. P.

BOWBELLS, N. D.—The National Briquetting Company, of Kenmare, has applied for an electric light franchise here. P.

SHERIDAN, MONT.—The Madison Power Company is planning to supply electric light here and at Alder and Laurin. C.

MILWAUKEE, WIS.—The Milwaukee-Western Electric Company is planning the extension of its line to Beaver Dam, Wis. C.

BRAHAM, MINN.—The Council has granted a franchise to the Eastern Minnesota Power Company to install an electric light plant.

VALLEJO, CAL.—The City Council has decided to call an election to vote upon the issuing of bonds for a municipal lighting plant. A.

ALTOONA, PA.—Another section of the boulevard lighting system has now been installed, and other extensions are soon to be made.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Light & Power Company will develop additional water power at its local plant. P.

DALLAS CENTER, IOWA.—A ten-year franchise has been voted to the Aael Mill Company to furnish the town with electric power.

FOND DU LAC, WIS.—Business men are subscribing for the installation of curb lights on Main Street from Division to Fourth Streets. C.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company has applied for a fifty-year electric lighting franchise in this city. A.

SIOUX CITY, IOWA.—The Council will endeavor to have the Service Company bring electric power from the Niobrara River to Sioux City. C.

TULARE, CAL.—The Tulare County Power Company, through C. H. Holly, manager, has applied for an electric lighting franchise in this city. A.

MANILLA, IOWA.—A franchise has been granted to the Manilla Electric Light Company, and a plant will be constructed with local capital.

LITCHFIELD, MINN.—Superintendent Aveldson will shortly commence the extension of the electric light system to the south side of Ripley. C.

LIBBY, MONT.—The Libby Water Works, Electric Light & Power Company will commence the immediate installation of an electric light plant. C.

WEBSTER CITY, IOWA.—Bonds have been voted for the construction of a municipal electric light and power plant at an estimated cost of $50,000. C.

ROCKVILLE CENTRE, N. Y.—This village will expend $11,000 on the improvement of its electric lighting system. Bonds have been voted for this purpose.

CHAMBERLAIN, S. D.—A company has been organized by local capitalists with a capital of $50,000 to install an electric light system. J. H. Kennedy is secretary. C.

FAYETTEVILLE, ARK.—The Fayetteville Electric Light & Power Company announces that it will expend $20,000 in enlarging and making improvements to its plant.

HOAG, NEB.—Dr. C. B. Fall and others are planning the construction of a dam on the Blue River to develop 500 horsepower to supply electric light to Beatrice and other towns. C.

WINDSOR, ONT.—The Sandwich, Windsor & Amherstburg Railway has proposed to the City Council to supply current for street lighting at $35 per horsepower per annum.

IRON MOUNTAIN, MICH.—The Peninsula Power Company has been organized to construct a dam for the development of 7,000 to 8,000 horsepower from Twin Falls to Menominee. C.

OGDEN, UTAH.—Active operations recently were started on the construction of the transmission line of the Merchants' Light & Power Company, which will light the streets of this place.

SAN BERNARDINO, CAL.—The Pacific Light & Power Company was awarded the contract for putting in the new city electric light system. Magnetite arcs will be used for street lighting.

WESTERLY, R. I.—The Westerly Light & Power Company has commenced work on extensions which are to run to Pleasant View. A number of cottages at Pleasant View have already been wired.

DOWNINGTON, PA.—The Chester Valley Electric Light, Heat & Power Company has purchased a tract of land on Brandywine Creek and will erect a power house there. The cost will be about $75,000.

SPRINGFIELD, MO.—It is reported that W. A. Bixby, general manager of the Springfield Traction and Springfield Gas & Electric Companies, has been authorized to spend $300,000 for improving the systems.

EAST BUTLER, PA.—Additions are to be made to the plant of the Pittsburg-Hickson Company here, which will probably be completed by July 1. New boilers and a new generator will be installed.

MOTLEY, MINN.—Clem Thompson, representing the St. Paul and Brainerd capitalists, will erect a power dam on the Crow Wing River to supply light and power to the towns springing up in the Cuyuna range. C.

GREENEVILLE, TENN.—A vote will be taken on June 5 on the proposition of issuing $65,000 in bonds for the purpose of building an electric light and water plant. Power may be obtained from the Chuckey River.

FT. WORTH, TEX.—Ground has been broken for the $1,000,000 power plant which is to be built by J. R. Nutt and associates, of Cleveland, O. The plant is to have a capacity of 11,000 kilowatts and is to be hydraulically operated.

MISHICOT, WIS.—Ira Beyer and Peter Rowlier are negotiating with the Acker Electric Company, Sheboygan, Wis., for the installation of an electric light and water plant, power to be secured from a dam in the Mishicot River. C.

PASADENA, CAL.—Bids will be received by the city clerk up to June 6 for furnishing the city with a turbo-generator unit, an exciter, Tirrill regulator, etc., together with condenser pumps and auxiliaries of 1,500 to 1,650-kilowatt capacity. A.

BOISE, IDAHO.—The Indian Cove Reclamation Company has been incorporated to generate and distribute electric power. The concern is capitalized at $100,000 and was incorporated by T. S. Risser, T. C. Coffin and E. L. Hice, all of Boise.

LONG BEACH, CAL.—The Municipal Water Commission has secured estimates showing that it will cost $900,000 to buy out and connect the two private plants now in operation in the city, while it will cost $1,400,000 to build a suitable new plant. A.

DENVER, PA.—D. S. Martin is organizing a concern to be known as the Denver Electric Light & Power Company to furnish light for this borough. The officers are: President, J. W. Moore; vice-president, Robert Immel; secretary, Oscar Witter.

ATLANTIC CITY, N. J.—The plant of the Atlantic City Electric Company recently built on the Thoroughfare, will probably be put in operation early this month. Cables have been run direct to the Steel Pier and the plant will illuminate the entire structure.

COULEE CITY, WASH.—The City Council has granted to the Pacific Power & Light Company a franchise for an electric lighting and power distributing system in this place. The same company has secured a franchise covering the roads and highways of Benton County. A.

MONTREAL, CAN.—The Canadian Light & Power Company has purchased the Central Light, Heat & Power Company of Montreal, at $500,000. The latter company will give to the Canadian Light & Power Company means to distribute its power in the city of Montreal.

MEDFORD, ORE.—The Klamath Power Company has now secured franchises covering the public highways of Josephine and Jackson Counties in southern Oregon and will extend its lines to cover the territory between here and Grant's Pass, a distance of about thirty miles. A.

CHAMBERLAIN, S. D.—A company has been incorporated to install a new electric lighting system here. The new company is capitalized at $50,000, and the officers are: W. Han Irens, president; George McDonald, vice-president; J. H. Kennedy, secretary; Arthur Olson, treasurer.

EBENSBURG, PA.—It is reported that the Utilities Corporation of New Jersey expects to extend its system to Cambria and Indiana Counties. The company owns the Penn Central Light & Power Company, of Altoona, and recently purchased the system of the Hallidaysburg Electric Light Company.

RIVERHEAD, L. I.—The new electrical plant installed at the new jail has been formally turned over to the county and has been accepted. It is now providing light for the entire collection of county buildings here. The plant includes a high-speed engine, a dynamo, switchboard and a storage battery plant.

GARDNER, MASS.—The Gardner Electric Light Company has started preliminary work stringing wires to Westminster, Hubbardston and Barre, where the company has accepted contracts for municipal lighting. It is probable that the work will be completed and current supplied to these towns by fall.

COOPERSBURG, PA.—The Coopersburg Light, Heat & Power Company was recently organized with a capital stock of $5,000. Officers are as follows: President, C. H. Stoneback; Secretary, W. R. Jordan, and Treasurer, Robert D. Barron, and three other directors, C. F. Newcomer, Milton Jordan and Ray A. Young.

MARSHALL, MICH.—It is reported that the Commonwealth Power Company has offered W. W. Cleveland, of Marengo, $12,000 for his mill and site on the Kalamazoo River. It is said that the company proposes to build a big power dam across the Kalamazoo River similar to the ones at Ceresco, Plainwell and Allegan.

LOS ANGELES, CAL.—The Southern California Edison Company has filed application with the United States Engineering Offices at Los Angeles for permission to erect a transmission line across Cerritos slough west of Long Beach harbor. The application states that the company proposes to maintain the transmission line on towers at least 140 feet above water. A.

PORTLAND, ORE.—The Mt. Hood Railway & Power Company

began turning the machinery in its new steam electric power plant on the peninsula and will soon distribute electric current. The plant will generate 4,000 horsepower. This plant will replace the power heretofore secured from the power plant of the Monarch Lumber Company, the use of this plant having reverted to the lumber company.

SAN FRANCISCO, CAL.—Further particulars concerning the contract of the Pacific Gas & Electric Company to supply current to the Spring Valley Water Company show that about 1,000 horsepower is to be supplied for general construction purposes at the Calaveras dam and about 1,500 horsepower for traction purposes. It is understood that an electric traction line eight miles long will be built to carry materials to the dam site.

VERDI, NEV.—The Truckee River General Electric Company is now planning to have its plant at this place in working order by September 1. Water will be taken from the Truckee River at this place and carried through a ditch thirty-six feet wide to a point two miles below town. There will be a penstock 2,100 feet long, the water being dropped eighty-five feet to the turbines. The plant will consist of one generator which will develop about 3,200 horsepower.

GREENVILLE, CAL.—The Indian Valley Light & Power Company, which recently increased its capital stock to $500,000, has secured the S. P. Dunn water rights on the Feather River near Seneca in Plumas County, Cal., and will enlarge its plant at once. It is estimated that the water rights secured will allow of the generation of 25,000 horsepower. Plans for a power house and surveys for a ditch and transmission line are now under way. Heinrich Homberger is consulting engineer for the company. A.

INDEPENDENCE, KAN.—The Kansas Gas & Electric Company has acquired all the property and franchises of the Independence Electric Company, Independence, Kan. The Kansas Gas & Electric Company was incorporated in 1909 to acquire by consolidation the United Gas Company, Edison Light & Power Company, Gas & Electrical Appliance Company of Wichita, Kan., and the Home Light, Heat & Power Company of Pittsburg and Frontenac, Kan. The company is controlled by the American Power & Light Company.

HUMBOLDT, IOWA.—The Northern Iowa Power Company, which is now working on the building of a big cement dam across the Des Moines River here and which, with a new steel and cement power house and other improvements, will expend some $80,000 here, has completed arrangements for a similar work at Ft. Dodge. The expenditure there is expected to reach about $200,000 and a water-power plant, ranging from 1,000 to 4,000 horsepower, according to the stage of the river, will be built. The plant here will be connected to the one at Ft. Dodge.

RICHMOND, VA.—The Appalachian Power Company, of Richmond, has been chartered with an authorized capital of $25,000,000. The promoters are New York City and Chicago capitalists. The operations of the company will be confined to the counties of southwest Virginia, with rights to enter any city. The towns of Pocahontas, Graham, Bluefield, Princeton and Bramwell are among those which will be touched by the lines of the company. Robert E. Scott, of this city, is one of the directors of the new company, the officers of which are: H. M. Byllesby, president, Chicago; C. M. Wells, vice-president, New York; Elmer Dover, secretary, Chicago, and R. J. Graff, treasurer, Chicago.

ELECTRIC RAILWAYS.

(Special Correspondence.)

CALGARY, ALTA.—The Alberta Electric Railway Company will rush the construction of seventy-nine miles of road to Banff. C.

ESCANABA, MICH.—The Escanaba Traction Company will issue bonds for $250,000 for the establishment of new enterprises.

HOULTON, ME.—A new electric road will be built this year between Woodlawn and New Sweden. It may later be extended to Caribou.

IOWA CITY, IOWA.—Stock to the amount of $100,000 has been purchased for the construction of the Iowa City-Davenport Interurban Company's line. C.

CLEBURNE, TEX.—The street car line is soon to be extended through Bellevue addition. The line will then operate between the city and Lovelady's Park.

WATERLOO, IOWA.—A survey is being made for the construction of a second interurban line to Eagle Center, passing through Geneseo, Traer and Crystal. C.

TURLOCK, CAL.—The Tidewater & Southern Railroad Company has applied for a franchise for an electric railway through this city. The same company has a similar application pending in Modesto, Cal. A.

BAKERSFIELD, CAL.—The Bakersfield & Kern Electric Railway Company has been incorporated here with a capital stock of $250,000 by C. R. Eager, S. B. Cushing, H. A. Blodgett, E. T. Whorff and C. N. Beal. A.

NAPA, CAL.—Superintendent M. McIntyre of the San Francisco & Napa Valley Electric Railway announces that the steel has been ordered and that the company's extension to Calistoga will be built at once. A.

SIOUX CITY, IOWA.—The South Dakota Interurban Railway Company will shortly commence the construction of an electric railway to Chamberlain, via the Bijou Hills. W. E. Miller, of Academy, S. D., is interested. C.

HUTCHINSON, KAN.—A company has been organized to build an electric line from Meade south through Miles, Kan., and Hatten, Okla., to Beaver, Okla. The road will be about forty miles in length. F. Corp, of Hutchinson, is promoting the project.

CLEVELAND, O.—Limited interurban service is to be established between Cleveland and Detroit, according to plans of the Lake Shore Electric Company and the Detroit United Railways Company. The trip will take little more than six hours.

ST. PAUL, MINN.—The Interurban Construction Company will build a line from Hastings to Cannon Falls and Pine Island, ending the road at Rochester. The new line will shorten the running time between Rochester and St. Paul by about one hour.

FAIRMONT, W. VA.—The Grafton, Fairmont & Clarksburg Traction Company plans to construct thirty miles of track, running from Fetterton to Bridgeport, by way of Boothsville, thence to Fairmont. The sale of the stock, and the purchase of a right of way have been authorized.

GRAND RAPIDS, WIS.—The Chicago & Wisconsin Valley Railway Company is planning to connect Rothschild, which is a few miles south of Wausau, with the Grand Rapids electric line, which runs from that city along the west bank of the river to Nekoosa, a distance of seven miles.

CHICAGO, ILL.—The Chicago & Joliet Railroad Company filed articles of incorporation with a capital of $5,000. The offices are to be in Chicago. The object is to build a line from Chicago to Joliet. The incorporators are J. R. Blackhall, Joliet; H. K. Crafts, George M. Stevens, William B. Stevens and Clayton E. Crafts, Chicago. The construction of the road will not be begun at once.

HASTINGS, MINN.—The Interurban Construction Company was recently organized with a capital of $100,000. The incorporators are: A. T. Stebbins of Rochester, Senator Albert Schaller of Hastings, and Edward Feldhauser of St. Paul. The company is authorized to build street railways and operate telegraph and telephone lines. It has been formed to construct an electric railway line from the twin cities to Lake City.

DENVER, COLO.—The Colorado Interurban Railway Company has incorporated with a capital of $6,000,000. It will operate in Denver, Boulder, Jefferson, Adams, Larimer and Weld counties and is planned to connect Ault, Pierce, Eaton, Greeley, Fort Lupton, Firestone, Longmont, Idaho Creek, Fort Collins and other points. The incorporators are: Edward E. Armour, Dewert E. Young, Charles H. Pierce, E. V. Reaser, Irving Hale, James Leonard, James W. Owen, A. H. Williams, W. H. Davis, S. F. Eaton, O. S. Storrs, Emil J. Reithmann and C. N. Guyer.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

CHARLES CITY, IOWA.—C. B. Way, of Mason City, is preparing to rebuild the entire telephone system. C.

SURPRISE, NEB.—The Council has granted a franchise to the Aitkin-Deerwood Telephone Company to install a plant. C.

GLENDALE, IOWA.—The Glendale Telephone Company, capital $2,500, has been incorporated. John S. Wilson is secretary. C.

DES MOINES, IOWA.—The Iowa Telephone Company is planning the expenditure of thousands of dollars in improving its service in the state. C.

PLEASANTVILLE, IOWA.—The Knoxville Electric Company is planning extensive improvements of the local system, including the construction of the exchange. C.

BAGLEY, MINN.—The Clover Telephone Company has been incorporated with a capital of $25,000. The incorporators are C. R. Bailey, Oscar Barness and M. J. Kolb.

TILTON, N. H.—The Canterbury & Boston Telephone Company, which is affiliated with the Citizens Telephone Company, is building new lines to Penacook and London.

MACON, GA.—A charter has been asked for the Dry Branch Telephone Company, which proposes to establish an independent telephone system throughout Twiggs County.

WALWORTH, WIS.—The Walworth Telephone Company was recently incorporated with a capital of $25,000. The incorporators are E. A. Walters, C. M. Maxon and F. E. Lawon.

WHEELING, W. VA.—The West Virginia Telephone Company will issue receiver's certificates to the amount of $15,000, of which $10,000 is to be used in making repairs and extensions.

LAKE MILLS, IOWA.—The Center Telephone Company was recently incorporated with a capital of $5,000 by M. T. Peterson, R. J. Jensen, A. A. Fruiten, P. L. Dahlen and T. N. Truile.

TOPPENISH, WASH.—Since the installation of the new exchange here the service of the Yakima Valley Telephone Company has improved, and the number of subscribers materially increased.

VAN BUREN, ARK.—The North Arkansas Telephone Company has been extending its lines to this city from Fayetteville. The Southwestern Telephone & Telegraph Company is to connect with the North Arkansas Company.

ELECTRICAL SECURITIES.

The recent action of the directors of the Republic Iron & Steel Company of announcing a determination to pursue a more aggressive sales policy, has had the effect at least of attracting the attention of the financial world. Although the prices of some securities have fallen somewhat, many others show substantial advances. The General Electric stock is noticeable as having advanced 4⅜, Westinghouse 3¾, and Western Union Telegraph 4½.

Gross receipts of Brooklyn Rapid Transit have been showing large gains under the stimulus of the ideal trolley-riding conditions. For the first three weeks of May gross had been gaining at the rate of $5,000 daily, or $150,000 for the month.

Chicago Telephone Company next fall will issue about $5,000,000 more first mortgage five-per-cent bonds, this being the company's first financing since present outstanding $5,000,000 bonds were marketed early in 1909. The mortgage provides that balance of authorized $5,000,000 may be issued at rate not exceeding $5,000,000 annually and never above fifty per cent of total assets. President Sunny says: "Chicago Telephone bonds to be issued are for new construction in Chicago and the ten counties covered by our operations. The extension is not extraordinary but in line with our regular growth of 38,000 telephones, which will equal this year. Gross revenues show steady growth, but larger payrolls and other operating expenses absorb full proportion, leaving the net about the same as last year."

The Chicago Elevated Railways, the new company which is to take over the different elevated roads in Chicago, will issue $25,000,000 common stock. This will make the capitalization of the new company $71,000,000, consisting of $16,000,000 preferred stock and $30,000,000 three-year five-per-cent notes, in addition to the proposed issue of $25,000,000 common stock. This will be a material reduction from the aggregate capitalization now outstanding of the different roads.

DIVIDENDS.

Chicago City Railways; regular quarterly dividend of two and one-half per cent, payable June 30 to stock of record June 13.

Mackay Companies; regular quarterly dividends of one per cent on the preferred and one and one-fourth per cent on the common, payable July 1 to stock of record June 10.

Muskogee Gas & Electric Company; preferred dividend of one and three-fourths per cent, payable June 15.

Norfolk Railway & Light Company; semi-annual dividend of two and one-half per cent, payable June 8.

Oklahoma Gas & Electric Company; quarterly dividend of two per cent, payable June 15.

San Diego Consolidated Gas & Electric Company; common quarterly dividend of one and three-fourths per cent, payable June 15.

Westinghouse Electric & Manufacturing Company; preferred quarterly dividend of one and three-fourths per cent, payable July 15.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.	May 29.	May 22.
Allis-Chalmers common	8¼	8
Allis-Chalmers preferred	30¼	30
Amalgamated Copper	67	67¼
American Tel. and Cable	81	*82
American Tel. & Tel.	148⅝	148½
Brooklyn Rapid Transit	79¾	80½
General Electric	164¼	159¾
Interborough-Metropolitan common	18½	18½
Interborough-Metropolitan preferred	52	52
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	89½	91⅞
Mackay Companies (Postal Telegraph and Cables) preferred	75	76¼
Manhattan Elevated	136	135
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	50½	49½
U. S. Steel common	77	80⅜
U. S. Steel preferred	119	119¾
Western Union	82¼	77½
Westinghouse common	77¼	73½
Westinghouse preferred	117	116¾

*Last price quoted.

BOSTON.	May 29.	May 22.
American Tel. & Tel.	148¾	148⅝
Edison Elec. Illuminating	287	287
General Electric	164	159½
Massachusetts Electric common	20¾	19¾
Massachusetts Electric preferred	89½	89
New England Telephone	146	145
Western Tel. & Tel. common	19	18½
Western Tel. & Tel. preferred	94	94

PHILADELPHIA.	May 29.	May 22.
American Railways	43¾	44
Electric Company of America	12	12
Electric Storage Battery common	53	54
Electric Storage Battery preferred	53	54
Philadelphia Electric	16⅝	16¾
Philadelphia Rapid Transit	17¼	18⅜
Philadelphia Traction	83	83½

CHICAGO.	May 29.	May 22.
Union Traction	46	46¾
Chicago Railways, Series 1	75	75
Chicago Railways, Series 2	22½	21½
Chicago Subway	4	4¾
Chicago Telephone	121	123
Commonwealth Edison	129	127
Metropolitan Elevated common	25½	23½
Metropolitan Elevated preferred	72	70½

PERSONAL MENTION.

J. C. WOODSAM was recently appointed manager of the Tampa Electric Company, at Tampa, Fla., to take the place of J. A. Trawick, who is to take charge of the Stone & Webster interests at Keokuk, Iowa.

WILLIAM G. McADOO, builder of the Hudson tunnels, was hurt recently while riding in an automobile near Freehold, N. J. The machine suddenly overturned, throwing Mr. McAdoo out and breaking two of his ribs. While his injuries were painful they were in no way serious.

FRANK E. MARCY, who was formerly manager of the Salt Lake City office of the Allis-Chalmers Company, has been made manager of the branch house of the Mine & Smelting Supply Company at Salt Lake City, Utah.

J. M. KNAPP, of Buffalo, has been made general manager of the Friendship Telephone Company, the organization which recently took over the Onondaga Telephone Company of Syracuse, N. Y., and the Home Telephone Company of Utica.

WILLIAM H. COUGHLIN has resigned his position as superintendent of the Worcester Electric Light Company, Worcester, Mass., the resignation to take effect on July 1. Fred H. Smith succeeds Mr. Coughlin, who will, after his resignation, be retained by the company for a time in an advisory capacity.

FREDERICK E. VOEGELIN, of Boston, spent several days recently in an inspection of the work of the Public Service Commission of the Second District of New York. Mr. Voegelin is a representative of Governor Eugene N. Foss of Massachusetts, and has been assigned by him to the investigation of the business affairs of the Commonwealth, particularly the investigation of commissions which relate to public utilities.

H. P. RIDGELY, formerly connected with the electrical engineering department of the Milwaukee Electric Railway & Light Company, recently resigned to accept a position in the electrical engineering department of Smith, Kerry & Chace, Toronto, Ont. Mr. Ridgely is a graduate of Purdue University, and after graduation spent eight years in the testing department, power-station design, and construction department of the General Electric Company. He was in charge of the electrical construction and was later electrical superintendent of the plant of the Southern Wisconsin Power Company at Kilbourn, Wis.

ROBERT T. LOZIER has become connected with Messrs. Kountze Brothers, bankers, as engineer of the investment securities department. Kountze Brothers occupy a prominent position in banking circles both in this country and abroad, and deal in high-grade securities such as town and school bonds and the bonds and stocks of public utility corporations that are operating on a well-established basis. Mr. Lozier is one of the best-known engineers in this country, and since the early days of electrical engineering and designing has been prominently connected with the most important organizations manufacturing electrical apparatus and engaged in electrical and civil engineering. Latterly he has been particularly enaged in expert consulting work dealing with the investigation and appraisal of utilities, and this department of the company will find a source of great strength in Mr. Lozier's connection.

GEORGE BELL, formerly with the Westinghouse Electric & Manufacturing Company, has become associated with the Duncan Electric Manufacturing Company, of Lafayette, Ind., as sales manager. Mr. Bell prepared for college at Mercersburg Academy, Mercersburg, Pa., and took the electrical engineering course at Lafayette College. Upon leaving college, he entered the apprenticeship course of the Westinghouse Electric & Manufacturing Company, and after spending one and one-half years in their shops, entered the sales department, spending some time in the offices at East Pittsburg, and later joining the sales force in the Atlanta office. After spending eight months there, he was transferred to the Cincinnati office. In the fall of 1906, Mr. Bell was sent to Indianapolis to build up his company's business in Indiana, and the following spring opened the Indianapolis office, where he remained in charge until he resigned his position in October, 1910, to get some experience in central-station work. Mr. Bell was connected with the Westinghouse Company for almost ten years, and is well fitted for his new position. He has acquired an interest in the Duncan Electric Manufacturing Company.

OBITUARY.

JAMES RUTHERFORD GORDON, born fifty-six years ago in Canada, died from heart disease on May 16. At the time of his death he was living at Savannah, Georgia. Mr. Gordon was connected with the sales department of the Westinghouse Electric & Manufacturing Company for a period of twenty-five years, acting as district manager for the Southeastern states with headquarters in Atlanta for twelve years. In 1908 he resigned from the Westinghouse Electric & Manufacturing Company's employ and took charge of the power apparatus department of the Western Electric Company in the Southern territory, acting as power-apparatus manager. After a year and a half with this company he resigned to take up hydroelectric development work. He is survived by a wife and son, John H. Gordon. The interment took place at McKeesport, Pa., May 31.

LEGAL NOTES.

RATES CANNOT BE FIXED BY POPULAR VOTE OR THE INITIATIVE.—The charter of the city of Dallas empowers its Board of Commissioners to fix and regulate the charges of holders of public franchises after a fair hearing on the reasonableness of the rates. It also contains a provision for the initiative and referendum. The Supreme Court of Texas, however, does not think that the charter should be construed to authorize the fixing of telephone rates by the initiatory method. It says that in the exercise of the power to regulate and fix rates, etc., there must be a body which can hear evidence and decide upon the reasonableness or unreasonableness of the rate or regulation, and if that cannot be done by the initiative—the popular vote—then the authority cannot be exercised in that manner.—Southwestern Telegraph & Telephone Company vs. City of Dallas, 134 S. W. 321.

ELECTRICITY A "SUPPLY" FOR MINING.—An Oregon statute gives a lien to anyone who furnishes "supplies" for the working or development of any mine. In holding that this includes electricity, the Supreme Court of Oregon says that electricity, when employed to illuminate a mine, enables laborers to work therein with almost the same success as in daylight, thus materially contributing to the search for and the development of a mineral vein. By the use of copper wires electricity can be transmitted from the place where it is generated to the mouth of a mine in almost inaccessible mountains and ravines, and there be successfully used to operate quartz mills. Mines which a few years ago were almost worthless, have, by the employment of electricity, become very valuable, affording profitable employment to laborers and yielding rich returns to the owners. Electricity is capable of propelling machinery and of illuminating mine and mill by continuous operation, and as this modern agent is consumed by its use, so far as susceptible of discernment, and supplies a very urgent need tending to the proper working and development of a mine, it is believed that such force is a "supply" within the scope of that term.

NEW PUBLICATIONS.

PAN AMERICAN CONFERENCE.—The proceedings of the Pan American Commercial Conference which was held at Washington, D. C., have been put in book form for distribution. The book contains a remarkable amount of information concerning Pan American trade relations and will be of great use to those interested in foreign trade.

NEW YORK COMMISSION.—The annual report of the Public Service Commission for the First District, State of New York, for the year 1909, has been issued in three volumes. The first contains considerable discussion of the rapid-transit problem; the second contains the orders, opinions and report of the Commission, and the third contains reports of the gas, electric and railway companies, etc.

SAMPLING OF COAL IN THE MINE.—The first of a series of technical papers has been published under the above title by the Bureau of Mines. The plan of sampling is discussed, this plan being as follows: (1) Each group of mine samples submitted for analysis to represent fairly the commercial shipments of coal from the mine in which they are collected; (2) the complete history of each sample to be known and recorded; and (3) each sample to be analyzed promptly and by the best standard method.

PROPOSALS.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule No.
June 13—Cable, paper insulated		1,980 feet	Philadelphia, Pa.	3640
	Cable, submarine	2,400 feet	Philadelphia, Pa.	3642
	Cable	8,405 feet	Philadelphia, Pa.	3642
	Conduit, steel	300 feet	Philadelphia, Pa.	3640
	Conduit, vitrified clay	Miscellaneous	Philadelphia, Pa.	3640
	Do	13,500 feet	Philadelphia, Pa.	3642
	Supplies, electrical	Miscellaneous	Philadelphia, Pa.	3642
	Switches, oil, 2,300-volt	2	Philadelphia, Pa.	3642
	Transformers, 5-K.W.	3	Philadelphia, Pa.	3640
	Wire, copper, weather-proof	3,075 pounds	Philadelphia, Pa.	3642
June 20—Sets, wireless telegraph		6	Brooklyn, N. Y.	3635
June 27—Conductor, single		3,000 feet	Puget Sd., Wash.	3655

NEW INCORPORATIONS.

MANHATTAN, N. Y.—The Staley Elevator & Machine Company has been incorporated by Marcellus Staley, Judson J. Staley and Herman Moskowitz. The capital is $20,000.

NASHVILLE, TENN.—The Lytle Electric Company was recently incorporated with a capital of $5,000 by P. W. Lytle, H. P. Woods, W. C. Tupper, W. M. Waters, and H. H. Barker.

MANHATTAN, N. Y.—The American Electric Water Purifying Machine Company has been incorporated with a capital of $500,000 to manufacture electric water-sterilizing machinery. The incorporators are H. H. Brockway, Samuel Garrison and Watson A. Guthrie.

INDUSTRIAL ITEMS.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., is advertising its alternating-current generators by means of calendar post cards.

THE MORRIS IRON COMPANY, Frederick, Md., describes and illustrates its line of poles, posts, standards, brackets and specialties for outdoor lighting in a recent bulletin. Specifications and prices are given throughout.

THE BROOKFIELD GLASS COMPANY, New York, N. Y., lists its line of screw glass insulators in a recent catalogue, No. 50. A full-sized illustration of each insulator is shown, together with a statement of weight and other data pertaining to it.

JAMES G. BIDDLE, Philadelphia, Pa., has issued a small pamphlet listing the foreign and American companies from which he obtains scientific instruments. Among these are many such well known firms as Siemens & Halske, Hartman & Braun, Carl Zeiss and others of this class.

G. M. GEST, New York, N. Y., is distributing folders calling attention to his emergency crews, and the rapidity with which one of these crews can commence the installation of underground conduit systems. A map showing the cities where work has been done and the location of the Gest offices is included.

AGENS & HOPPER, Newark, N. J., which was incorporated under the laws of New Jersey, has bought up the business formerly conducted by the Electric Motor & Equipment Company. The new company will be jobbers of lighting, power and signaling supplies. The president is S. H. M. Agens, and the treasurer, Roland I. Hopper.

THE RAIL JOINT COMPANY, New York, N. Y., exclusive makers of base-supporting rail joints, describes and illustrates its line of material in a recent publication. An interesting fact in connection with this publication is the statement made in the preface, that the number of base-supporting rail joints delivered by the company, and in service, would more than equip a double-track railway completely encircling the globe.

THE NORTHWESTERN ELECTRICAL EQUIPMENT COMPANY, Portland, Ore., announces that it will in the future represent the American Electric Fuse Company, Muskegon, Mich., and the Hygrade Incandescent Lamp Company, of Danvers, Mass. The company will also handle overhead material for electric railways, steel transmission towers and electric hammers and tools. W. H. Barnes is president and manager of the new firm.

SCHUCHARDT & SCHUTTE, New York, N. Y., have issued a circular containing a detailed description of their new hand tachometer. Changes have been introduced which makes this instrument a combined tachometer and cutmeter, being equally convenient for indicating rotative as well as progressive speed. The circular will be of especial interest to those concerned with the perfecting of scientific methods of shop management.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued a number of bulletins under the following titles: "Allis-Chalmers Air Compressors"; "Huntington Mills"; "Electric Hoists"; "Steam Turbines and Generators"; "Log Machinery"; and "Centrifugal Pumps." The bulletin describing the steam turbines is especially worthy of mention, as the subject is gone into quite fully and numerous diagrams are utilized to make clearer the exact principle of operation. Many illustrations of parts and of the entire

THE NATIONAL ELECTRIC LAMP ASSOCIATION has issued through its engineering department Bulletin No. 13-A, dealing with "Mazda" multiple lamps provided with drawn-wire filaments. The employment of ductile tungsten, drawn into a fine strong wire, makes a rugged-filament lamp of much higher quality than has ever been obtained before. Mazda multiple lamps are now available in twenty-one forms, thirteen being designed for 100-125 volts, and eight for 200-250 volts. The lamps range in power consumption from 25 to 500 watts.

THE KERR TURBINE COMPANY, Wellsville, N. Y., has been reorganized and $125,000 new capital added. The stock interests of the company are now controlled by F. P. Merrill, of Hornell, N. Y., and P. B. Hanks, of Wellsville, who, as trustees, have directed the affairs of this company for the past two and a half years. Mr. Kerr is no longer with the company, his position as chief engineer now being filled by J. L. Moore, formerly a designer with the Westinghouse Electric & Manufacturing Company, and later in the engineering department of the Santa Fe Railroad. It is the intention of the new company to incorporate into the Kerr turbine design changes which are based upon two years' experiments and which will improve the steam economy on all sizes from fifteen to twenty per cent.

THE NATIONAL CARBON COMPANY, Cleveland, O., has prepared a cloth-bound book of pocket size dealing with the "Practical Operation of Arc Lamps." The construction of the various types of lamps is taken up and a chapter deals with the rules which should be followed to secure proper operation of lamps at all times. Various troubles are treated separately and the remedy given for each case of faulty operation. A number of practical tables are also given. A carefully arranged index is found at the close of the book and makes it possible easily and quickly to locate any article in it. No advertisements are scattered through

its pages, and the general editorial policy carried out is that of thorough and practical information which the company and its various lamp engineers and salesmen have found by years of practical experience that lamp owners and operators ask for. A copy of the book will be sent free to any one connected with the construction, operation, or maintenance of arc lamps of any form, upon request to the National Carbon Company.

THE CHICAGO ARMATURE & MOTOR COMPANY, 552 West Harrison Street, Chicago, was recently formed to do a general electrical repairing business. The company makes a specialty of rewinding alternating-current motors and is equipped to make motor, generator and transformer repairs, rewind armature and field coils, and refill commutators. Leonard C. Jones, the president of the company, has had eighteen years' experience in the above line. He was formerly foreman in the transformer department of the Westinghouse Company, and for a number of years was with the Western Electric Company. Up to February 1, 1911, he had charge of the General Electric Company's repair shop in Chicago. Gustav Jost, vice-president of the company, has had fourteen years' experience in electrical repair work. He was for a number of years connected with the Northern Electrical Manufacturing Company at Madison, Wis.; also with the Siemens & Halske Company, and was foreman of the armature department of the Northwestern Elevated Railroad Company, Chicago.

DATES AHEAD.

National District Heating Association. Annual meeting, Pittsburg, Pa., June 6-8.

Canadian National Electrical Credit Association. Toronto, Ont., June 13-16.

American Society of Civil Engineers. Annual convention, Chattanooga, Tenn., June 13-16.

Association of Railway Electrical Engineers. Semi-annual convention, Washington Terminal Station, Washington, D. C., June 16 and 17.

National Gas and Gasoline Engine Trades Association. Convention, Detroit, Mich., June 19-23.

Association of Railway Telegraph Superintendents. Annual meeting, Boston, Mass., June 26-30.

Michigan Electric Association. Annual convention, on board steamer *Minnesota*, leaving Grand Haven, Mich., June 19, returning to St. Joseph, Mich., June 22.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

Canadian Electrical Association. Annual convention, Niagara Falls, Ont., June 21-23.

American Instiute of Chemical Engineers. Semi-annual meeting, Chicago, Ill., June 21 to 24.

Society for the Promotion of Engineering Education. Annual meeting, Pittsburg, Pa., June 26, 27 and 28.

American Institute of Electrical Engineers. Annual convention, Chicago, Ill., June 26-30.

American Society for Testing Materials. Annual meeting, Atlantic City, N. J., June 27 to July 1.

American Chemical Society. Annual meeting, Indianapolis, Ind., June 28-30.

National Electrical Contractors' Association. Niagara Falls, N. Y., July 19.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 25-28.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9 to 13.

Association of Railway Electrical Engineers. Annual convention, LaSalle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) May 23, 1911.

992,756. LAMP BRACKET. William H. Cross, Dayton, Ohio. Filed Feb. 13, 1911. Consists of a group of duplex swiveled arms adjustable in a practically universal manner. The furthest arm carries an incandescent lamp.

992,768. ELECTRIC METER. Jesse Harris, Rensselaer, N. Y. Filed Sept. 26, 1906. A permanent strap magnet is bent so its poles lie in parallel superposed planes between which the movable element swings.

992,791. WIRELESS TELEGRAPHY. James F. McElroy, Albany, N. Y. Filed Oct. 4, 1905. A terminal apparatus comprises insulated antennae, means for producing electric waves having their positive portions coincident and also their negative portions coincident in the direction of desired transmission, but non-coincident in other directions, the instrument in circuit having its leads connected with the ends of the antennae.

992,792. LAMP. Arthur K. Miller, Peekskill, N. Y. Filed July 22, 1910. An electric carriage lamp has an outer globe clamped between two caps which are connected through a means for mounting the lamp on the vehicle.

992,817. METHOD OF AMPLIFYING ELECTRIC CURRENTS. Louis W. Southgate, Worcester, Mass. Filed July 10, 1908. Renewed Oct. 14, 1910. Consists in applying current to the field of a polyphase generator, utilizing the currents generated in it to create a rotating magnetic field, physically rotating the coils of the field in opposition to its magnetic rotation so that the lines of force thereof will stand stationary in space, and utilizing the lines of force to energize the secondary of a transformer, the primary of which is formed by the rotating field.

992,821. ELECTRICAL CLAMP OR ADJUSTER. William Burnett Stewart, Philadelphia, Pa. Filed Nov. 16, 1910. Has two jaw members adapted to grasp the wires and a clamp member to hold the jaws in place.

992,824. VENTILATING MECHANISM. Bernard A. Stowe, Cleveland, Ohio, assignor to Adams-Bagnall Electric Company, Cleveland, Ohio. Filed July 6, 1909. Comprises a pendent base adapted to be secured to a ceiling, a number of supports adjustably held in the base so as to incline at various angles in substantially vertical planes, and electric fans carried by the supports.

992,829. PROCESS OF DESICCATING AIR. Herbert T. Weston, Cleveland, Ohio. Filed Aug. 25, 1909. Consists in passing high-tension electrical discharges through a flowing stream of air, thereby causing a reduction of the hygroscopic tension of the air, and in then causing the air stream to flow through a closed chamber over refrigerated surfaces, whereby moisture released from the air is condensed.

992,836. PARTY-LINE RINGING SYSTEM. Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Filed Sept. 16, 1908. Associated with the cord circuit is a test device, a supervisory relay and ringing key arranged so that talking current will not pass through its series contacts.

992,846. FIELD-MAGNET STRUCTURE. Arthur J. Brown, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed April 19, 1909. Bracing plates are introduced between adjoining poles of a rotating field.

992,851. CONTROLLING DEVICE. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed Sept. 13, 1909. A multiple-voltage controller has an arm movable to change the resistance, and means for changing the connections so that the arm may be moved in the opposite direction for the same purpose.

992,852. MOTOR-CONTROL SYSTEM. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed April 15, 1910. A water rheostat includes a casing containing water and electrodes within the casing, in combination with a unitary power-operated device for gradually varying the height of the electrodes in relation to the level of the liquid in the casing.

992,865. MEANS FOR REPAIRING COMMUTATORS. Friedrich C. Fischer, Philadelphia, Pa. Filed Sept. 19, 1910. The machine comprises a bracket, a sleeve carried thereby, a framing journaled in the sleeve, manually controlled means for rotatively adjusting the framing, a head slidably carried by the framing, means for adjusting the head longitudinally, a saw carried by the head and means for rotating the saw.

992,870. CENTRIFUGAL SWITCH. Clarence B. Hanright, Cambridge, Mass., assignor to Holtzer-Cabot Electric Co., Brookline, Mass. Filed June 14, 1909. Has weighted arms pivotally connected to a shaft so as to swing outwardly against the force of a spring and thus to close a switch suddenly when a certain critical speed is attained.

992,881. MEANS FOR ACCUMULATING, CONCENTRATING, STORING AND USING WASTE HEAT. Joseph Moses Ward Kitchen, East Orange, N. J. Filed June 24, 1909. Consists of a producer-gas equipment, a gas engine supplied thereby, a superheater for utilizing the waste heat from the engine and converting it into steam, and a steam engine driving electric generators.

992,883. DYNAMO-ELECTRIC MACHINE. Arthur F. Kwis, Cleveland, Ohio, assignor to Allis-Chalmers Co. Filed May 13, 1909. Generator ventilation is secured by placing a housing over the stator and providing it with radial ribs having air vents regulated by dampers.

992,919. WEIGHING SCALE. Walter Standish Smith, Columbus, Ohio, assignor to Columbus Electric Scale Co., Columbus, Ohio. Filed Oct. 12, 1908. The beam has a contact which closes an electric-signal circuit when the beam is not balanced.

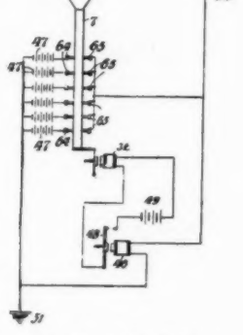
992,926. AUTOMATIC APPARATUS FOR MEASURING AND INDICATING SIZES OF TILES. William B. Updegraff, New York, N. Y. Filed June 17, 1910. Includes a feeler arm which engages each tile and operates an electric signal and indicating device, according to the size of the tile.

992,943. DYNAMO-ELECTRIC MACHINE. William A. Dick, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Dec. 31, 1908. An armature for unipolar machines has two sets of collector rings and armature conductors between the sets of rings, each conductor comprising two circumferentially offset parts and a multi-strand connector between the adjacent ends of the parts.

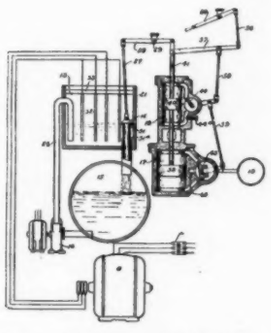
992,951. PROCESS FOR THE MANUFACTURE OF DUCTILE ELECTROLYTIC IRON. Franz Fischer, Berlin, Germany. Filed Oct. 23, 1909. Consists in adding calcium chloride to a solution of ferrous dioxide and then electrolyzing the solution at a temperature exceeding 70 degrees centigrade.

992,952. PROCESS FOR THE MANUFACTURE OF DUCTILE ELECTROLYTIC IRON. Franz Fischer, Charlottenburg, Germany. Filed Aug. 29, 1910. Comprises the combination of ferrous sulphate and sodium chloride in the electrolyte, to form non-hygroscopic salts.

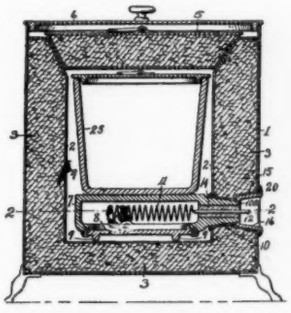
992,965. DYNAMO-ELECTRIC MACHINE. Albert Kingsbury, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Jan. 11, 1909. A rotor for unipolar machines comprising a magnetizable cylindrical core, a number of collector rings mounted thereon, and a number of spring steel plates disposed as ring segments between the core and collector rings.



993,024.—COHERER.



993,027.—WATER RHEOSTAT.



993,178.—ELECTRIC COOKER.

992,969. ELECTRIC-LIGHT FIXTURE. William McCanse, Hobart, Okla. Filed Dec. 22, 1909. A casing contains a drum for winding up the cord of an extensible chandelier.

992,980. OZONE-PRODUCING APPARATUS. Octave Patin, Paris, France. Original application filed Sept. 22, 1908. Divided and this application filed Sept. 29, 1910. Comprises two concentrically arranged glass tubes, an inner electrode positioned within and frictionally engaging the central tube, and an outer electrode formed of wire wound to form a helix in spiral form upon the outer tube.

992,992. COMBINED LAMP SUPPORT AND AUTOMATIC TIMING MECHANISM. George H. Rupley, Schenectady, N. Y., assignor of one-half to Frank J. Seabolt and one-fourth to Edward C. Hall, Schenectady, N. Y., and one-fourth to Edward F. Pickford, Washington, D. C. Filed Aug. 10, 1906. Combined with an electrolier is a clock mechanism mounted in the casing thereof, an electric motor geared to the spring shaft of the clock to wind the spring, a contactor driven by the clock mechanism and winding mechanism for controlling the motor, a lamp socket in the electrolier and circuit connections to the lamp, contactor and motor.

992,993. WEATHERPROOF ELECTRICAL RECEPTACLE. Frank J. Russell, New York, N. Y. Filed March 18, 1908. The body is provided in one face thereof with retaining grooves, and a spiral wire plug-holder having ends seated in the grooves.

993,024. COHERER. Edward J. Burke, New York, N. Y., assignor of one-half to John Q. A. Whittemore, Newton, Mass. Filed Oct. 29, 1906. Includes means for feeding coherable material through the coherer as long as impulses are received.

993,027. LIQUID RHEOSTAT. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Co. Original application filed April 15, 1910. Divided and this application filed Sept. 6, 1910. A polyphase water rheostat has four plates in line and dipping an adjustable distance into the water. The plates have enlargements near the top and the outer plates are connected together.

993,030. AUTOMATIC ENGINE STARTER. Clyde J. Coleman, New York, N. Y., assignor to Conrad Hubert, New York, N. Y. Filed Aug. 12, 1907. Includes means for concurrently opening and closing the ignition contact terminals and the fluid inlet valves.

993,042. NICKEL ALLOY FOR HIGH RESISTANCES. Wilbur B. Driver, East Orange, N. J. Filed May 9, 1906. An alloy consisting of nickel not less than fifty per cent, manganese from ten to thirty per cent, and the remainder of copper.

993,046. SYSTEM OF TRANSMITTING SIGNALS ELECTRICALLY THROUGH CONDUCTORS. Frank Fisher, New York, N. Y. Filed Feb. 3, 1910. Shunt circuits to ground are provided each with a condenser and an adjustable resistance.

993,062. ELECTROSTATIC VOLTMETER. Harry E. Heath, Hartford, Conn., assignor to Baker Electric Co., Hartford, Conn. Filed July 6, 1908. Comprises a pair of terminal plates arranged side by side in operative relation to one another, a disk of insulating material secured to each terminal, the edges of the disks being connected to form a chamber, a dielectric substance in the chamber, and an indicator actuated by the dielectric substance.

993,072. ELECTRICALLY CONTROLLED VALVE. Richard T. Jones, Baltimore, Md. Filed July 29, 1910. An air valve is operated by an electromagnet.

993,076. COLLECTOR-RING FOR DYNAMO-ELECTRIC MACHINES. Albert Kingsbury, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Sept. 6, 1910. Comprises inner and outer ring members and an interposed resilient spacer composed of a series of plates of resilient material having envelopes of high current conductivity.

993,098. SERVICE TERMINAL BLOCK. Granville E. Palmer, Boston, Mass., and Walter E. McCoy, New York, N. Y. Filed Jan. 22, 1910. Comprises a fuse, a switch and a current-measuring device, through all of which the connection between the line and load circuit may be established and means in connection with the block for establishing a fused by-pass around the switch fuse and measuring device so that either device may be entirely removed during the uninterrupted continuity of the service connection.

993,099. METER CONNECTION BLOCK. Granville E. Palmer, Hartford, Conn. Filed Oct. 14, 1910. Terminals mounted on an insulating block are provided with spring contacts and fuses.

993,105. ELECTRIC SMELTING AND REFINING APPARATUS. James Henry Reid, Newark, N. J., assignor to George Goodwin, Ottawa, Canada. Filed Aug. 18, 1910. The electrodes extend through the wall of the treating chamber in such a way as to form a temporary retaining chamber for the finely-divided material to be treated. A collecting chamber separated from the treating chamber is adapted to receive the material after it has passed through the arc, and means are provided for passing the hot gases rising from the material in the collecting chamber about the finely-divided material before it passes into the arc.

993,123. METER AND OUTLET BOX. Joseph G. Swallow and Walter E. McCoy, New York, N. Y., assignors of one-third to Frank W. Smith, New York, N. Y. Filed Feb. 6, 1909. Combines a casing, a movable cover, a meter mounted upon its cover, a meter-testing block within the casing, flexible conductors connecting the meter to the block, and pivoted parallel ruler bars connected between cover and casing and holding the cover parallel to a given plane in both closed and opened position.

993,168. TEMPERATURE INDICATOR OR ALARM. Max Louis Huberman, Los Angeles, Cal. Filed Dec. 17, 1908. A thermostatic diaphragm actuates a contact which moves between two adjustable contact points.

993,178. ELECTRIC COOKER. James D. Lamont, Detroit, Mich., assignor of one-half to Ellsworth S. Bryant, Detroit, Mich. Filed June 13, 1910. Has a cooking chamber, a hollow burner in the chamber, a resistance coil within the burner, the wall of the burner having a laterally extending neck, the wall of the case having an opening to receive the neck of the burner.

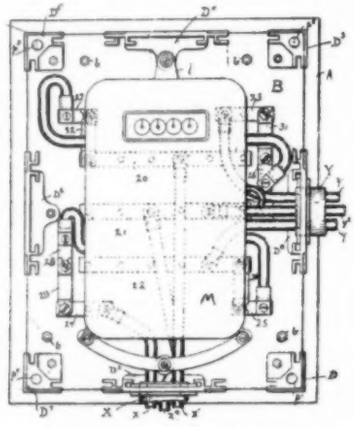
993,204. BRUSH HOLDER FOR ELECTRIC METERS. Gustave A. Scheeffer, Indianapolis, Ind., assignor to Columbia Meter Co., Indianapolis, Ind. Filed Jan. 14, 1910. Combines a rocker arm, brush holders rotatably supported by such rocker arm, adjustable stops carried by such brush holders and a common stop carried by the rocker arm and co-operating with the adjustable stops.

993,206. ELECTRIC WATER HEATER. Milton H. Shoenberg, San Francisco, Cal., assignor to Presto Electrical Manufacturing Co., San Francisco, Cal. Filed Jan. 27, 1911. Comprises a tubular casing, a cap secured thereto having a chamber provided with an electric switch, a tubular heater element within the casing having a surrounding insulated resistance coil connected to the switch. The switch is so arranged that it is closed by the flow of water, and opens again when the flow ceases.

993,214. SPARK PLUG. Otto C. Winestock, Perkinsville, Vt. Filed July 27, 1909. Has sparking terminals, one of which is in the form of an annulus with a carrying yoke offset from and having its legs joined to the annulus at diametrically opposite points of the latter.

993,219. CAR FENDER. Hugh Sinclair Beattie, Teziutlan, Mexico. Filed June 21, 1910. Electromagnets depress the fender of a car and put it in the operating position when an object is struck.

993,251. ILLUMINATING SYSTEM FOR THEATRICAL DISPLAY. Louis Samuel Howard, Wichita, Kan. Filed Jan. 7, 1911. A pair of wires wound around a rope form sections of different polarity so that a tight-rope walker may by properly placing his



993,311.—CONNECTION BLOCK.

feet, complete the circuit through metal foot plates and leads, and light a lamp which he carries.

993,270. PRODUCTION OF METALS AND ALLOYS. Alwin Nieske, Dresden, and Enrich Muller, Stuttgart, Germany. Filed Sept. 28, 1910. The production of metals and metal alloys in the electric furnace form carbon together with alkaline earth-metal compounds of other metals or the constructive elements of said compounds.

993,296. ADVERTISING DEVICE. George M. Guerrant and William R. Guerrant, Danville, Va., assignors to Virginia Patent Sales Corporation, Richmond, Va. Filed June 16, 1910. An electric light with projecting lenses is arranged to throw images of objects to be advertised.

993,301. ELECTRIC-LAMP REGULATOR. Emery Johnson, Newberg, Ore., assignor to Any Lite Incandescent Lamp Regulator Co. Filed April 28, 1909. Renewed Nov. 16, 1910. The device, which is adapted to be interposed between lamp and socket, comprises a reel-shaped body of non-conducting material having a series of radial arms, an exposed series of connected coils of high electrical resistance disposed in the lamp circuit and strung around the arms, and a pivoted spring brush included in the circuit and adapted to have its free end shifted by a turning movement across the coils.

993,307. METHOD OF ELECTRICALLY WELDING LAPPED SHEET METAL. George W. Knapp, Baltimore, Md., assignor to National Enameling & Stamping Co., Baltimore, Md. An outward-pressed inperforate bump is formed on one of the parts to be welded. The annular base thus formed is pressed into contact with the other piece to be welded and current is passed through.

993,310. ELECTRIC-MOTOR METER. Paul May, Charlottenburg, Germany. Filed March 10, 1908. Has a permanent magnet for creating a field of force, a rotable armature in this field being connected in series relation with the load, and a commutator with segments, which are divided along a helical line. Brushes connecting the commutator segment with the circuit are arranged on a lever and means are provided for turning the lever under the influence of the strength of the current flowing in the load circuit.

993,311. CONNECTION BLOCK. Walter E. McCoy, New York, N. Y., assignor of one-third to Frank W. Smith and one-third to Joseph G. Swallow, New York, N. Y. Filed Aug. 24, 1909. Combines an insulating base, an extended circuit terminal strap, two meter-terminal straps adjacent respectively to the ends of the extended terminal strap, an additional terminal strap adjacent to one of the meter-terminal straps and to the extended strap, all of the straps being mounted upon the base, a removable fuse joining the additional terminal strap and its adjacent meter-terminal strap and a removable connector joining the other meter-terminal strap and the extended terminal strap.

993,314. ELECTRICALLY HEATED VESSEL. Herman Mieth, Vancouver, British Columbia, Canada. Filed Jan. 3, 1911. Comprises an inner shell, an outer coating of insulation for the shell, an outer shell in which said inner shell is set, the inner shell being spaced from said outer shell, an inner heat-insulating lining for the outer shell and spaced from said inner shell, a heating coil wound around the inner shell within the space between the shells, and a cement filled in the space between the shells to unite the same and imbed the heating coil.

993,316. METER FOR ELECTROMAGNETIC-WAVE COMMUNICATION. Greenleaf Whittier Pickard, Amesbury, Mass. Filed July 1, 1907. Comprises a condenser; a charging circuit therefor; a discharging circuit for the condenser; a switch controlling both said circuits and constructed to automatically and normally close the charging circuit; and means for including in the discharging circuit, a receiving apparatus operable by the energy of the electromagnetic waves.

REISSUES.

13,244. AUTOMATIC PLAYING APPARATUS FOR MUSICAL INSTRUMENTS. Timothy Bernard Powers, New York, N. Y., and Major Romeyn Jewell, Chicago, Ill., assignors to Telelectric Co., Pittsfield, Mass. Filed March 1, 1906. Original No. 753,809, dated March 1, 1904. The combination with an electrically-operated key of a musical instrument, of a contact-finger and a non-rotating metal guide connected in the key-operating circuit, an electric conductor movable in the guide transversely of the finger in electrical contact with the guide, and means for making and breaking the contact between the finger and the conductor.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired May 29, 1911:

520,406. MAGNETO-TELEPHONE. Arthur F. Boardman, Somerville, Mass.
520,412. INSULATOR. Chauncey E. Conover, Cincinnati, O.
520,427. CIRCUIT-CLOSER. George W. Hey, Syracuse, N. Y.
520,429. ELECTRIC BATTERY. Samuel H. Hoggson, St. Louis, Mo.
520,445. ELECTRIC CIGAR-LIGHTER. David Missel, New York. N. Y.
520,446. ELECTRICALLY-ILLUMINATING CLOCK. David Misell, New York, N. Y.
520,467. SPEAKING ATTACHMENT FOR TELEPHONES. William Weber, Philadelphia, Pa.
520,474. SWITCH. Henry P. Ball, Bridgeport, Conn.
520,488. CHARGING-CRANE. Thomas R. Morgan, Sr., and William H. Morgan, Defiance, O.
520,510. ELECTRIC CATTLE-GUARD. David H. Wilson, Chicago, Ill.
520,520. SAFETY SYSTEM FOR RAILROADS. William H. Elkins, Cambridge, Mass.
520,527. ELECTRIC-RAILWAY TURNTABLE. Rudolph M. Hunter, Philadelphia, Pa.
520,602. INSULATOR. Henry H. Luscomb, Hartford, Conn.
520,606. INSULATOR. Louis McCarthy, Boston, Mass.
520,543. TESTING SYSTEM FOR MULTIPLE SWITCHBOARDS. Charles E. Scribner, Chicago, Ill.
520,547. FIRE-ALARM APPARATUS. Frederick J. Thunhorst, Allegheny, Pa.
520,585. ELECTRIC CLOCK STRIKING MECHANISM. Charles D. Warner, Ansonia, Conn.
520,614. ELEMENT FOR SECONDARY BATTERIES. Sigmund A. Rosenthal and Villeroy C. Doubleday, London, England.
520,620. ALTERNATING-CURRENT MOTOR. William Stanley, Jr., Pittsfield, Mass.
520,661. ELECTRIC RAILWAY-SIGNAL. Charles Selden and Henry V. Riley, Baltimore, Md.
520,673. THERAPEUTIC ELECTRODE. William B. Farrar, Greensborough, N. C.
520,710. ELECTRIC RAILWAY-SIGNAL. Charles Selden and Henry V. Riley, Baltimore, Md.
520,722. ELECTRIC PUMP-MOTOR. John F. Blake, New Haven, Conn.
520,748. METHOD OF OPERATING ELECTRIC MOTORS. John S. Bancroft, Philadelphia, Pa.